GE Healthcare

PROCARE* Monitor B40/B20

Technical Reference Manual

PROCARE Monitor B40/B20
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PROCARE Monitor B40/B20

Technical Reference Manual

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Conformity according to the Council Directive 93/42/EEC concerning Medical Devices

All specifications subject to change without notice.

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Classifications

In accordance with IEC 60601-1

– Class I and internally powered equipment - the type of protection against electric shock.
– Type BF or CF equipment. The degree of protection against electric shock is indicated by a symbol on each parameter module.
– Equipment is not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide.
– Continuous operation according to the mode of operation.
– Portable Monitor

In accordance with IEC 60529

– IP21 - degree of protection against harmful ingress of water.

In accordance with EU Medical Device Directive

– IIb.

In accordance with CISPR 11:

– Group 1 Class A;
  - Group 1 contains all ISM (Industrial, scientific and medical) equipment in which there is intentionally generated and/or used conductively coupled radio-frequency energy which is necessary for the internal functioning of the equipment itself.
  - Class A equipment is equipment suitable for use in all establishments other than domestic and those directly connected to a low-voltage power supply network which supplies buildings used for domestic purposes.

Trademarks

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1 Introduction

About this manual

Intended purpose of this device (Indications for use)

This device is a portable multiparameter unit to be used for monitoring and recording of, and to generate alarms for, multiple physiological parameters of adult, pediatric, and neonatal patients in a hospital environment and during intra-hospital transport. The B40/B20 Patient Monitor is intended for use under the direct supervision of a licensed health care practitioner.

The PROCARE Monitor B40/B20 is not intended for use during MRI.

The PROCARE Monitor B40/B20 monitors and displays oscillometric non-invasive blood pressure (systolic, diastolic and mean arterial pressure), invasive blood pressure, end-tidal carbon dioxide, heart/pulse rate, respiration rate, ECG (including arrhythmia and ST segment analysis), temperature with a reusable or disposable electronic thermometer for continual monitoring Esophageal/Nasopharyngeal/Tympanic/Rectal/Bladder/Axillary/Skin/Airway/Room/Myocardial/Core/Surface temperature, and functional oxygen saturation (SpO_2) and pulse rate via continuous monitoring, including monitoring during conditions of clinical patient motion or low perfusion.

Intended audience

This Technical reference manual is meant for service representatives and technical personnel who install, configure, maintain, administer, troubleshoot or repair B40/B20 monitor running the software license *VSP-A*.

Notes to the reader

As the monitor setup may vary, some functions described may not be available in the monitor you are using.

- The order code for the manual is **2050802-001.**
- Read the manual through and make sure that you understand the procedures described before the installation of the monitor. To avoid risks concerning safety or health, strictly observe the warning indications. If you need any assistance concerning the installation, please do not hesitate to contact your authorized distributor.

Installation without network are allowed by customer. The network installation and service are allowed by authorized service personnel only.

GE Healthcare assumes no responsibility for the use or reliability of its software in equipment that is not furnished by GE.

Responsibility of the manufacturer

GE Medical Systems *Information Technologies*, Inc. (GE) is responsible for the effects on safety, reliability and performance of the equipment only if:

– Assembly operations, extensions, readjustments, modifications, or repairs are carried out by persons authorized by GE.

– The electrical installation of the relevant room complies with the requirements of the appropriate regulations.

– The equipment is used in accordance with the “User's Guide.”

– The equipment is installed, maintained and serviced in accordance with this manual.

Product availability

Some of the product parts and accessories mentioned in this manual may not be available in all countries.
Please, consult your local representative for the availability.

Related documentation

– Clinical aspects, basic methods of measurement and technical background: PROCARE Monitor B40/B20 User's Reference Manual
– Options and selections of the software: PROCARE Monitor B40/B20 Default Configuration Worksheet
– Compatible supplies and accessories: PROCARE Monitor B40/B20 Supplies and Accessories
– Other devices closely related to the monitor:
  • iCentral and iCentral Client User's Reference Manual
  • CIC Pro Clinical Information Center Operator's Manual

Conventions used

To help you find and interpret information easily, the manual uses consistent text formats:

Sign the check form after performing the procedure.

Within this manual, special styles and formats are used to distinguish between terms viewed on screen, a button you must press, or a list of menu commands you must select:

– Names of hardware keys on the keypad are written in **bold** typeface: **NIBP Start/Cancel**.
– Menu items are written in ***bold italic*** typeface: ***Monitor Setup***.
– Emphasized text is in *italic* typeface.
– When referring to different sections in this manual, section names are enclosed in double quotes: "Cleaning and care".
– The word "select" means choosing and confirming.
– Messages (alarm messages, informative messages) displayed on the screen are written inside single quotes: '*Learning*.'
– Note statements provide application tips or other useful information.

Illustrations and names

All illustrations in this manual are only examples, and may not necessarily reflect your system settings or data displayed in your system. If a particular selection is not available in your system, the selection is shown grayed.

1 Overview

The B40/B20 is a modular multiparameter patient monitor. The monitor is especially designed for monitoring in intensive care units. It can also be used during transportation within the hospital.

The modular design makes the system flexible and easy to upgrade.

NOTE: Your system may not include all these components. Consult your local representative for the available components.

Figure 1 B40/B20 monitor with hemo and extension rack modules

1.1 Symbols

- On the rear panel this symbol indicates the following warnings and cautions:
  - Electric shock hazard. Do not open the cover or the back. Refer servicing to qualified personnel.
  - For continued protection against fire hazard, replace the fuse only with one of the same type and rating.
  - Disconnect from the power supply before servicing.
  - Do not touch the monitor during defibrillation.
  - Do not use the monitor without manufacturer approved mounting attached.

Electrostatic sensitive device. Connections should not be made to this device unless ESD precautionary procedures are followed.

Type BF (IEC 60601-1) protection against electric shock. Isolated (floating) applied part suitable for intentional external and internal application to the patient, excluding direct cardiac application.

Type BF (IEC 60601-1) defibrillator-proof protection against electric shock. Isolated (floating) applied part suitable for intentional external and internal application to the patient, excluding direct cardiac application.

Type CF (IEC 60601-1) protection against electric shock. Isolated (floating) applied part suitable for intentional external and internal application to the patient, including direct cardiac application.

Type CF (IEC 60601-1) defibrillator-proof protection against electric shock. Isolated (floating) applied part suitable for intentional external and internal application to the patient including direct cardiac application.

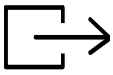
When displayed in the upper left corner of the screen, indicates that the audio OFF. When displayed in the menu or digit fields, indicates that the alarm source has been turned off or alarm does not meet the alarm-specific activation criteria.

In the front panel: battery

Equipotentiality. Monitor can be connected to potential equalization conductor.

Alternating current

Bell cancel. Audio pause.

	Home. Return to the main display.
	Standby or power indicator.
	Fuse. Replace the fuse only with one of the same type and rating
	Gas inlet.
	Gas outlet.
IP21	Degree of ingress protection.
SN,S/N	Serial number
	Date of manufacture. This symbol indicates the date of manufacture of this device. The four digits identify the year.
	Maunfacturer: This symbol indicates the name and the address of the manufacturer.
	European authorized representative.
	European Union Declaration of Conformity.
Rx Only U.S.	Prescriptive Device. USA only. For use by or on the order of a Physician or persons licensed by state law.
	Fragile. Handle with care.
	Keep dry. Protect from rain.
	This way up.
	Storage temperature
	This symbol depicts the transportation and storage atmospheric pressure range of 700 to 1060 hPa

Recycled materials or may be recycled.

This symbol indicates that the waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please, contact an authorized representative of the manufacturer for information concerning the decommissioning of your equipment.

The separate collection symbol is affixed to a battery, or its packaging, to advise you that the battery must be recycled or disposed of in accordance with local or country laws. To minimize potential effects on the environment and human health, it is important that all marked batteries that you remove from the product are properly recycled or disposed. For information on how the battery may be safely removed from the device, please consult the service manual or equipment instructions. Information on the potential effects on the environment and human health of the substances used in batteries is available at this url: http://www.gehealthcare.com/euen/weee-recycling/index.html

This product consists of devices that may contain mercury, which must be recycled or disposed of in accordance with local, state, or country laws. (Within this system, the backlight lamps in the monitor display contain mercury.)

Battery operation and remaining capacity. The height of the green bar indicates the charging level.

Battery (A) charging (white bar)

Battery (A) failure

Both batteries failed

Battery (A) missing

Submenu. Selecting a menu item with this symbol opens a new menu.

The monitor is connected to Network.

A blinking heart next to the heart rate or pulse rate value indicates the beats detected.

A lung next to the respiration rate value indicates that respiration rate is calculated from the impedance respiration measurement.

1.2 Safety information

1.2.1 General

This device is intended for use under the direct supervision of a licensed health care practitioner.

Contact GE for information before connecting any devices to the equipment that are not recommended in this manual.

Parts and accessories used must meet the requirements of the applicable IEC 60601 series safety standards, and/or the system configuration must meet the requirements of the IEC 60601-1-1 medical electrical systems standard.

Periodically, and whenever the integrity of the device is in doubt, test all functions.

The use of ACCESSORY equipment not complying with the equivalent safety requirements of this equipment may lead to a reduced level of safety of the resulting system. Consideration relating to the choice shall include:

- use of the accessory in the PATIENT VICINITY; and
- evidence that the safety certification of the ACCESSORY has been performed in accordance to the appropriate IEC 60601-1 and/or IEC 60601-1-1 harmonized national standard.

If the installation of the equipment, in the USA, will use 240V rather than 120V, the source must be a center-tapped, 240V, single-phase circuit.

1.2.2 Safety message signal words

Safety message signal words designate the severity of a potential hazard.

DANGER: Indicates a hazardous situation that, if not avoided, will result in death or serious injury. No danger messages apply to this system.

WARNING: Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION: Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

NOTE: Indicates a hazardous situation not related to personal injury that, if not avoided, could result in property damage.

1.2.3 Safety precautions

The following list contains general warnings and cautions you should know before installing, maintaining or servicing the system. Warnings and cautions specific to the use of the system can be found in the User's Guide and User's Reference Manual.

Warnings

- Use only GE recommended power cords
- When disconnecting the system from the power line, remove the plug from the wall outlet first
- Due to high voltage, use insulated screw driver
- High voltage on test body; do not touch it during the test

- To avoid the risk of electric shock, this equipment must only be connected to a supply mains with protective earth.
- Always check that power cord and plug are intact and undamaged
- All system devices must be connected to the same power supply circuit
- Only interconnect devices when determined safe by qualified biomedical personnel
- Only devices that are specified compliant with IEC 60950-1 or IEC 60601-1 may be connected to the Ethernet MC or IX ports
- Biomed must determine interconnected parts are safe.
- Do not use without manufacturer approved mounting
- If the software package is changed, all clinical settings will reset to factory defaults.
- Do not use with iCentral software V5.0.2 and earlier or Mobile Care Server software earlier of V5.2.
- Verify compatibility of all system components prior to installation
- Use only approved accessories, including mounts, and defibrillator-proof cables and invasive pressure transducers. For a list of approved accessories, see the supplies and accessories list delivered with the monitor. Other cables, transducers and accessories may cause a safety hazard, damage the equipment or system, result in increased emissions or decreased immunity of the equipment or system or interfere with the measurement.
- Regular preventive maintenance should be carried out annually.
- Do not use multiple modules with identical measurements in the same monitor.
- The user may only perform maintenance procedures specifically described in this manual.
- Incorrect power line frequency setting could adversely affect ECG processing.
- Make sure patient is not being monitored while servicing the equipment.
- Don’t press power key when changing language or doing factory reset.

Cautions

- Set the time of a newly added network device as close as possible to the time of devices already on the network

1.2.4 ESD precautionary procedures

- To avoid electrostatic charges building up, it is recommended to store, maintain and use the equipment at a relative humidity of 30% or greater. Floors should be covered by ESD dissipative carpets or similar. Non-synthetic clothing should be used when working with the component.
- To prevent applying a possible electrostatic discharge to the ESD sensitive parts of the equipment, one should touch the metallic frame of the component or a large metal object located close to the equipment. When working with the equipment and specifically when the ESD sensitive parts of the equipment may be touched, a grounded wrist strap intended for use with ESD sensitive equipment should be worn. Refer to the documentation provided with the wrist straps for details of proper use.

ESD precautionary procedure training

It is recommended that all potential users receive an explanation of the ESD warning symbol and training in ESD precautionary procedures.

The minimum contents of an ESD precautionary procedure training should include an introduction to the physics of electrostatic charge, the voltage levels that can occur in normal practice and the damage that can be done to electronic components if they are touched by an operator who is electrostatically charged. Further, an explanation should be given of methods to prevent build-up of electrostatic charge and how and why to discharge one's body to earth or to the frame of the equipment or bond oneself by means of a wrist strap to the equipment or the earth prior to making a connection.

1.2.5 Disposal

Dispose of the whole device, parts of it and its packing material and manuals in accordance with local environmental and waste disposal regulations.

1.3 Service information

1.3.1 Service requirements

Follow the service requirements listed below.

- Refer equipment servicing to GE authorized service personnel only.
- Any unauthorized attempt to repair equipment under warranty voids that warranty.
- It is the user's responsibility to report the need for service to GE or to one of their authorized agents.
- Failure on the part of the responsible individual, hospital, or institution using this equipment to implement a satisfactory maintenance schedule may cause undue equipment failure and possible health hazards.
- Regular maintenance, irrespective of usage, is essential to ensure that the equipment will always be functional when required.

1.3.2 Equipment identification

Every GE device has a unique serial number for identification. The device plate is located on the rear of the patient monitor.

Serial number for B40: **SN: SG2XXXXXXXXWA**

Serial number for B20: **SN: SGFXXXXXXXXWA**

2 System description

2.1 Introduction

The B40/B20 monitor build up a freely configurable modular system. The architecture is designed to enable different module combinations so that the user is able to get the desirable parameter and feature set. This modular approach makes it possible to add new features when they are needed.

2.2 Bus structure

The operation of monitor is based on two communication channels, the CPU bus and module bus. All units, including the modules, receive power from the same power supply, which is an integral part of the monitor frame.

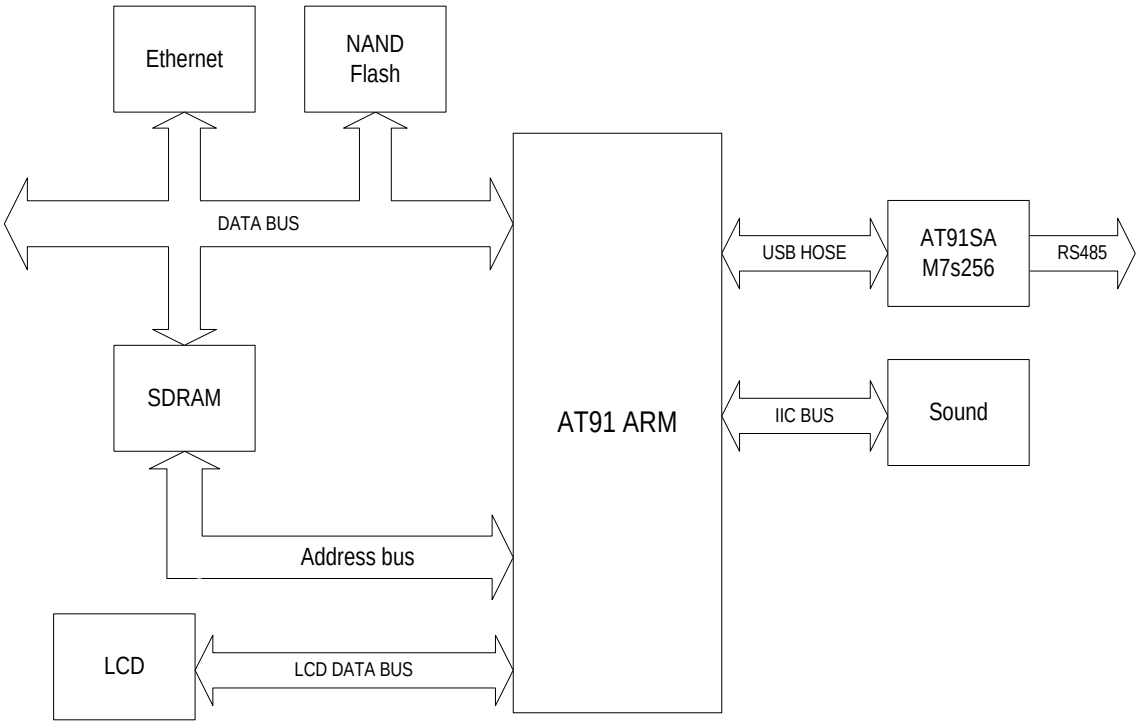


Figure 2 General bus structure of monitor

The CPU bus is a communication channel used only for internal data transfer. It is based on the AT91 ARM local bus. Data and address are transferred on this 32 bit wide bus using the CPU clock frequency.

The module bus is for the parameter modules. The bus is based on the industry standard RS-485, which uses a differential serial method to transfer data. The module bus uses a 500 kbps data transfer rate.

The RS-485 type of serial communication supports so-called multidrop or party line connections. This means that all parameter modules connected to the module bus use exactly the same lines for communication. The advantage of this is that all bus connectors are identical and the modules can be connected in any order and position.

2.3 Distributed processing

This is a multiprocessor system. All parameter modules have their own microprocessor, which performs functions such as waveform filtering, parameter related computing and pneumatic control, etc. At the same time the main CPU performs higher level tasks such as trending and alarm control. While the parameter modules and CPU are performing their tasks, the UPI (Universal Peripheral Interface) microprocessor handles all functions needed to transfer data between the parameter modules and the CPU.

This kind of parallel processing gives one major advantage to centralized processing. When new parameter modules are added to the system, the processing power is increased. As a result, the system does not slow down when new features are added.

2.4 Module communication

The communication master controlling data transfers between the CPU and parameter modules is called UPI processor. It sends data to each connected module 100 times a second. Modules respond to each data request immediately by sending a data package, whose length depends on the type of the module. This communication protocol ensures that each module receives and sends data every 10 ms. If a module does not respond to data requests, the UPI processor presumes that the module is disconnected.

The data transfered on USB bus between main CPU and UPI processor.

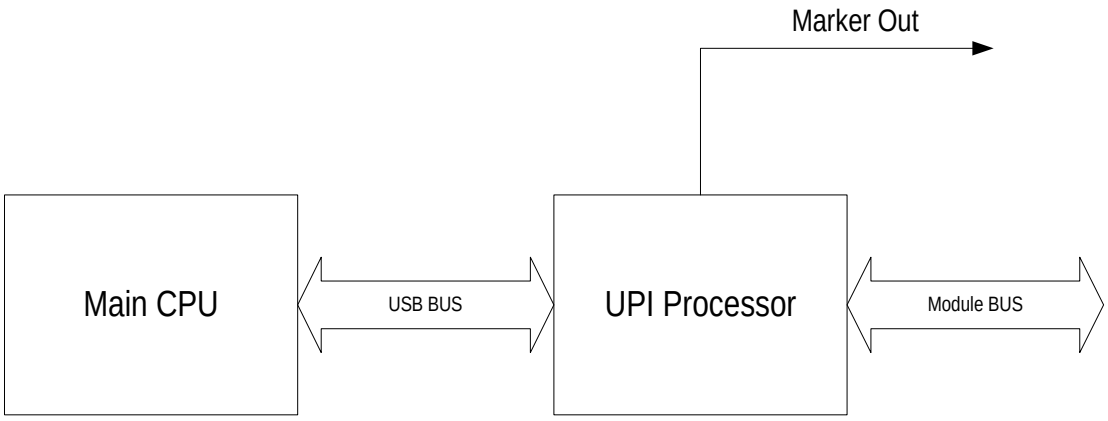


Figure 3 Principle of UPI section operation

2.5 Software loading

The program memory on the CPU board is loaded with monitor software and selected language files at the factory. The software is used for running all the functions that are integrated into the CPU board. For service upgrade main software and language files, please refer to "Software download instruction" in Appendix A or the “B40/B20 Patient Monitor Software download instruction”.

How to do cold start?

The patient monitor performs a cold start, if there is over 15 minutes from the previous power off. You can perform a cold start by 2 methods:

- Press **ON/Standby** button to turn off the monitor, waiting for 15 minutes to turn on the monitor. Or,
- Press **ON/Standby** button for a long time (about 15 seconds until the words "monitor is shutting downing..." disappear) to turn off the monitor. Then turn on the monitor.

NOTE: All the patient data and monitor settings will be lost after cold start.

2.6 Parameter modules

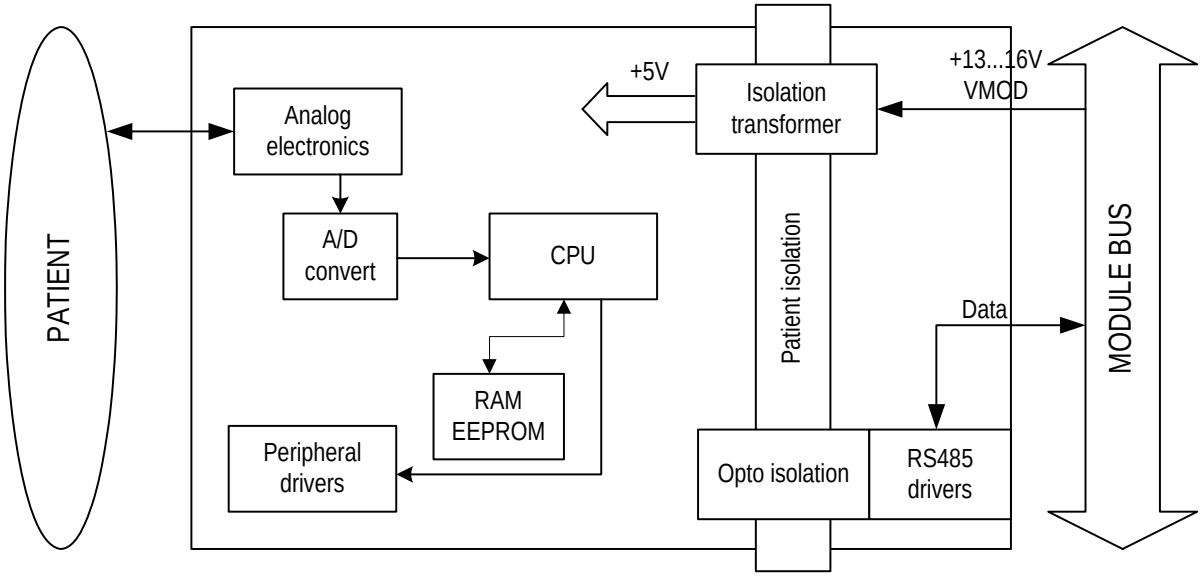


Figure 4 General structure of parameter modules with patient isolation

The detailed structure of a parameter module depends on the specific needs for each individual parameter. However, some common parts are used in the parameter modules. The electronics inside the module is usually divided into isolated (floating) and non-isolated sections. Typically, the non-isolated section consists of buffers to interface the parameter module to the module bus while the rest of the electronics is located in the isolated section. The isolated section includes the microcontroller together with memory components, the front-end analog electronics (amplifiers, etc.) and sensor drivers.

3 Frame functional description

3.1 Main components

3.1.1 Keyboards

User interface parts

The Horizontal Membrane keypad containing 17 keys. The keypads are foil membrane keypads. The keypads are connected to the UPI section of the CPU board.

Trim Knob is used for menu selection.

3.1.2 Display

The B40 use 12.1" LCD display with SVGA 800 x 600 resolution has bright long life lamps and a wide viewing angle.

The B20 use 10.4" LCD display with SVGA 800 x 600 resolution has bright long live lamps and a wide viewing angle.

NOTE: The LCD display backlight circuit runs on a high voltage. Do not touch the inverter board or the backlight tube leads when powered.

Backlights

The backlight lamp unit consists of two integrated cold cathode fluorescent lamps. The backlight lamp unit is driven by a separate inverter board.

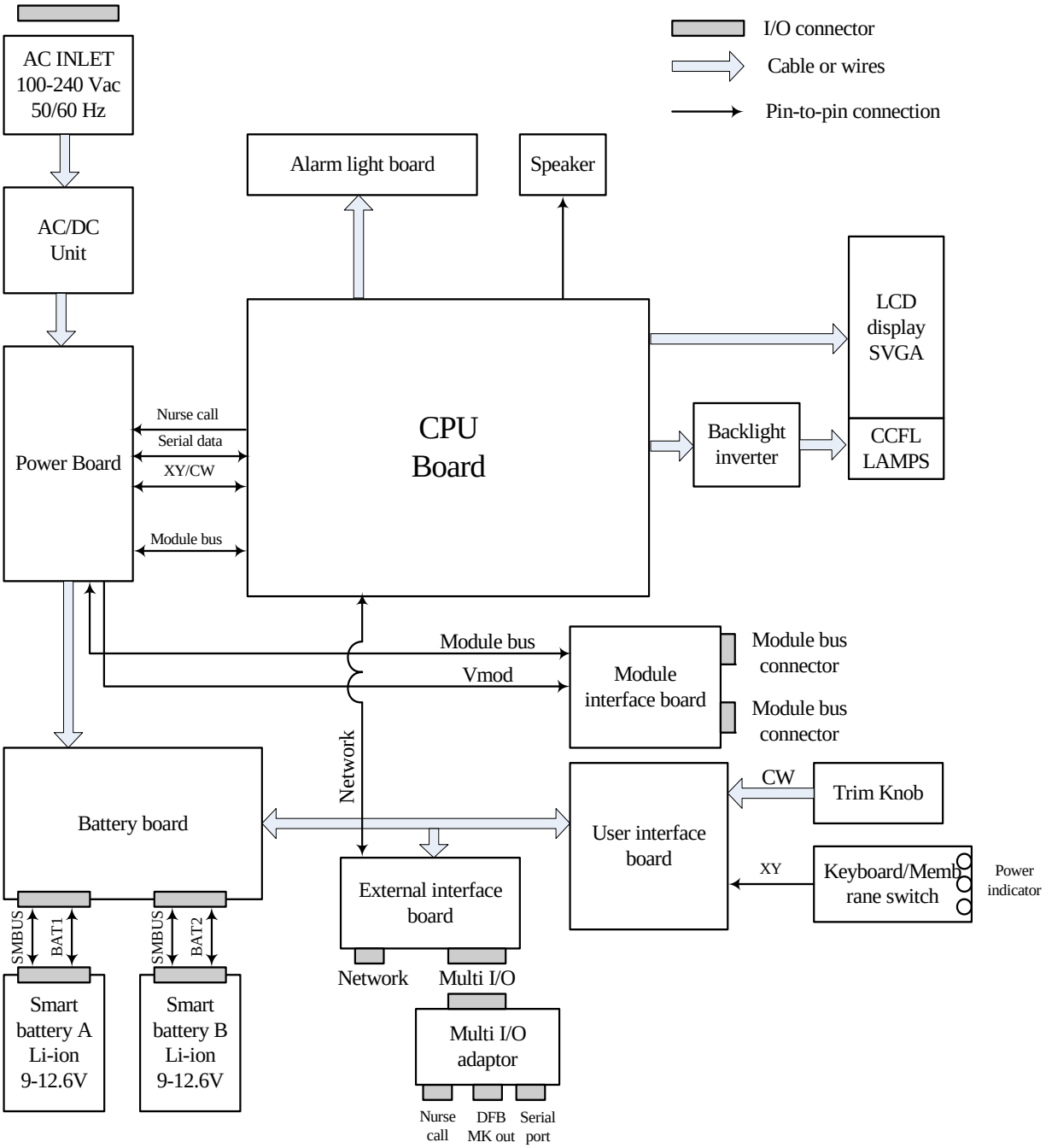


Figure 5 B40/B20 Monitor block diagram

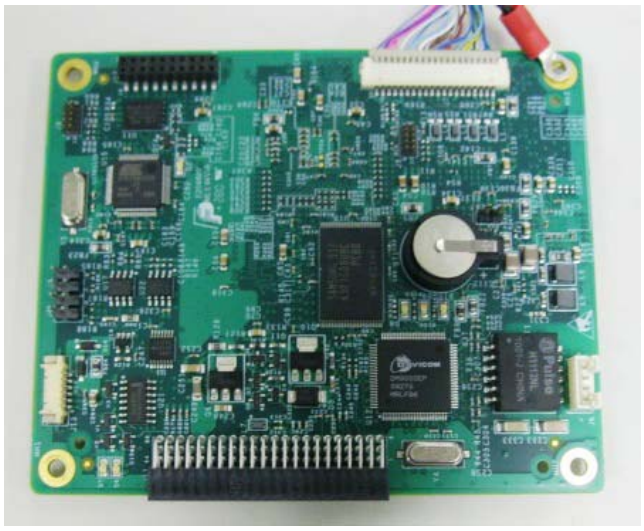
3.1.3 CPU board

The board is based on AT91 ARM microprocessor. Other functions include LVDS display driver, 10/100Mbps on board Ethernet, Alarm Light function, KEY board and rotor encoder control, audio driver function, nurse call function, defibrillation function, module bus function.

The CPU section takes care of the central processing.

The main features are:

- AT91 ARM
- 266 MHz Main CPU clock
- 64MBytes SDRAM
- 4 MBytes minimum NAND flash memory
- 8 MBytes Data flash memory
- Main CPU Provides one standard UART communication



Connectors

Ethernet communication connector

Color LCD operation connector

Audio operation connector

Alarm Light indicator operation connector

Power board connection connector

Voltage supervision

There are two voltage supervision chips that control the system reset signals.

The +3.3V supervision chip outputs reset signals for +3.3V devices. 3.3V Reset Threshold will be Falling: min 3.00 V; max 3.15 V.

The +1.2V supervision chip outputs reset signals for +1.2V devices. 1.2V Reset Threshold will be Falling: min 1.08V; max 1.14 V.

3.1.4 Power board

The Power board converts the output voltage of AC/DC unit and battery voltage to various supply voltages for the electronics of monitor. The Power board provides monitor system power function, module bus power function, LCD backlight power and power failure alarm.

Power board operation is controlled by PMC (Power Management Controller) CPU. PMC takes care of power path controlling. Power Board incorporates the SMBus interface between the PMC, battery charger IC, and smart battery.

Power board provides the system voltage for +3.3V, +5V. And Power Board provides 15V power for measurement modules connected patient monitor module bus.

The Boost converter of PMC system provides module voltage supply for measurement modules through patient monitor module bus.It operates at input voltage from 9V to15V.

Power Board create an power failure alarm for user to notice unexpected loss of power supply. It indicate power failure alarm by blinking patient monitor yellow alarm light and buzzer alarm.

Block diagram of the power supplies is represented in following

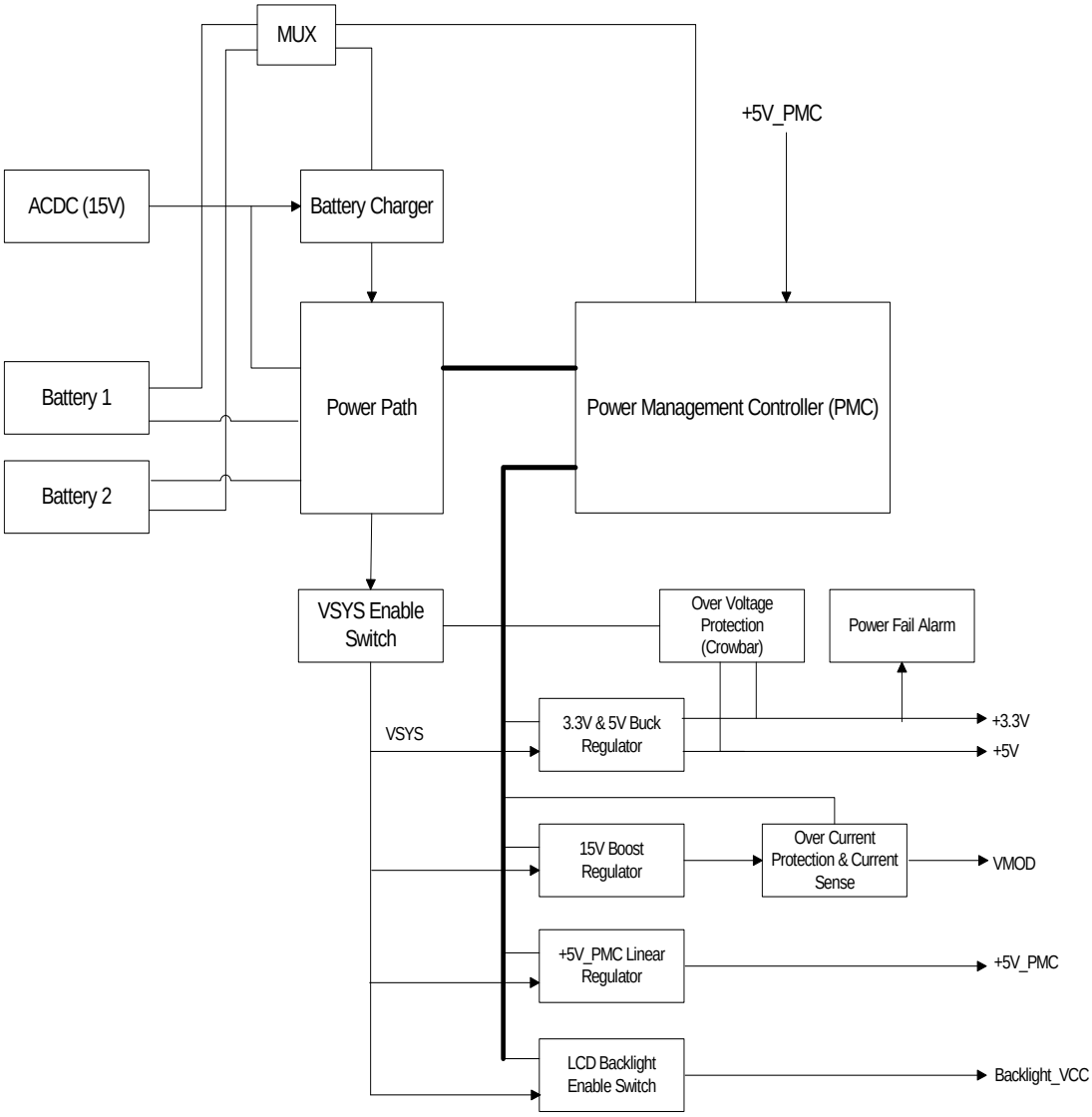


Figure 6 Power board block diagram

Power management controller

The power management controller (PMC) used is the Freescale MC9508AC60CFUE, 8 bit microcontroller. The PMC is used to:

- Control power supplies sequencing
- Monitor the power supply voltages and currents via internal analog to digital converters (ADCs)
- Disabling power supplies during fault conditions
- Communicate with the CPU board via UART communication
- Read and write to a IIC EEPROM
- Communicate with smart batteries and a level 2 smart battery charger via SMBus.

3.1.5 AC/DC unit

AC/DC unit

The AC/DC unit is a compact medical power supply based on high-efficiency technology. It is designed for 65 watt continuous output power, universal AC input and 15V output voltage.

3.1.6 Batteries

The B40/B20 has two lithium-ion batteries, located in the battery compartment. The power board connects one of the batteries to be the power source, if no power is received from the AC/DC unit.The battery charging is controlled by the power board.

The batteries can be charged separately, and screen symbols and monitor frame LED indicators indicate their charging level and possible failure.

NOTE: When the monitor is battery powered, the green battery LED is on. When the monitor is mains powered, the green mains LED is on.

3.2 Interfacing computer

A computer is connected to the serial port connector on the Multi I/O adapter.

Contact your authorized GE Healthcare distributor for further advice on computer interface.

WARNING **Connecting electrical equipment together or using the same extension cord for more than one device may cause their leakage currents to exceed the limits specified in relevant safety standards. Always make sure that the combination complies with the international safety standard IEC 60601-1-1 for medical electrical systems and with the requirements of local authorities.**

WARNING **Connecting the power supply cord of the computer to the wall power outlet may cause the computer leakage current to exceed the limit specified for medical equipment. A computer must be supplied from an additional transformer providing at least basic isolation (isolating or separating transformer).**

3.3 Connectors and signals

3.3.1 External connectors

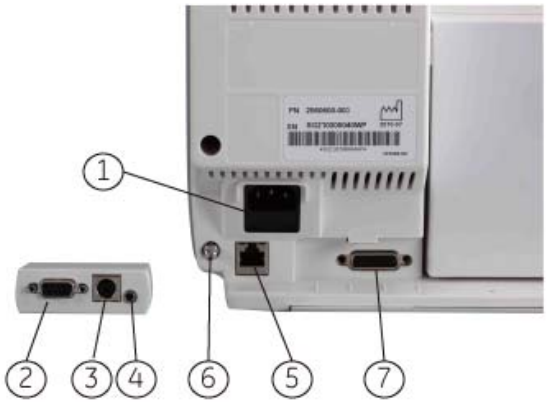
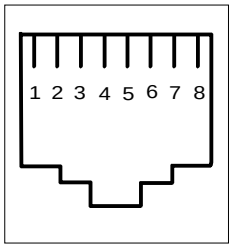


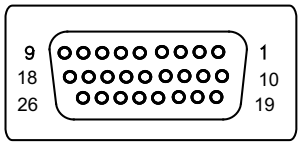
Figure 7 External connectors of Frame

(1) Receptacle for power cord
(2) Serial port
(3) Defibrillator connector
(4) Nurse call connector
(5) Network connector
(6) Equipotential connector
(7) Multi I/O connector

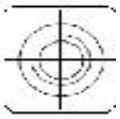
Network connector

RJ45 connector	Pin	Signal
	1 2 3 4 5 6 7 8	Tx + Tx - Rx + N/C N/C Rx - N/C N/C

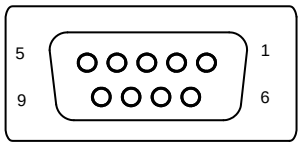
Multi I/O connector(26 pin)

26 pin female connector	Pin	Signal
	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26	GND NC NC NC NC NC SERIAL_TXD SERIAL _CTS# GND GND NC NC DEFIB_MARKER_OUT NC NC SERIAL_RXD SERIAL_RTS# GND GND NURSE_CALL NC NC NC NC SERIAL_+3V3 GND

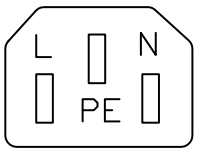
Nurse Call (pin 3)

Nurse call connector	Pin	Signal
	1 2 3	GND Nurse_Call Nurse_Call

Serial port

9 pin female connector	Pin	Signal
	1 2 3 4 5 6 7 8 9	GND SERIAL_RXD SERIAL_TXD SERIAL+3.3V GND N/C SERIAL_RTS SERIAL_CTS N/C

Main power

Mains connector	Pin	Signal
	L PE N	Live Protected earth Neutral

Defib connector (Pin 7)

Female mini din7 connector	Pin	Signal
	1 2 3 4 5 6 7	GND GND GND GND DEFIB_MARKER_OUT NC GND

4 Hemo-dynamic module introduction

The hemo module provide general hemodynamic parameters.

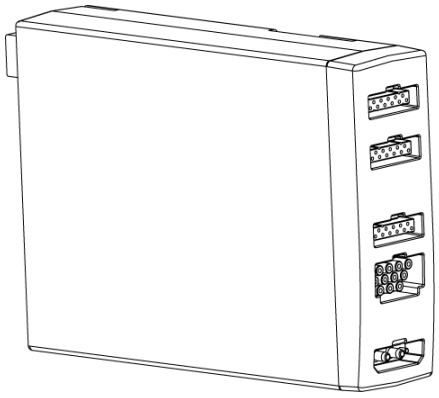


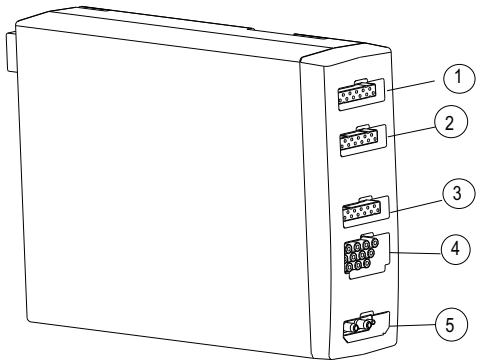
Figure 8 Hemo module

4.1 Monitor software compatibility

– B40/B20 Patient Monitor using software VSP-A

4.2 Main components

4.2.1 Hemo-dynamic module



1. InvBP connector
2. Temperature connector
3. SpO_2 connector
4. ECG connector
5. NIBP connector

Figure 9 Front panel of hemo module

The Hemo-dynamic module including the NIBP measurement, 5-lead ECG with the Impedance Respiration measurement, SpO_2 with the plethysmographic waveform, two invasive pressure measurements (IBP1 and IBP2) and two temperature measurements (T1 and T2).

The monitor displays waveforms and measurement readings, and handles the trending and alarm management. The ECG (e.g. heart beat and arrhythmia detection) and the Impedance Respiration algorithms are in the monitor software. The modules measure signals and send them to the monitor. The NIBP, SpO_2, Temperature and Invasive Pressure algorithms are in the module.

There are four parameter circuit boards inside the hemo-dynamic module for processing the measurement signals. Each processing board has a microcontroller with software.

The NIBP parameter measurement requires one signal processing board, pneumatic system, valve and pump unit connected to NIBP parameter board.

The second parameter board is the optional board, for Nellcor or Masimo SpO_2 measurement, it's Masimo MS-2011 board or Covidien NELL1GE-S board at different configuration.

The third parameter board is for GE SpO_2, IBP and Temperature measurement including input board. All these three parameter is optional, according to different configuration, using different board: it's STP board, TP board for Nellcor, TP board for Masimo, GE SpO_2 board.

The fourth parameter board is for 3/5-lead ECG with the Impedance Respiration measurement including ECG input unit connected to the ECG parameter board.

All parameter boards are connected together via module bus flex board connecting voltage and module communication, the module communicates with frame through RS-485 bus.

4.2.2 NIBP board

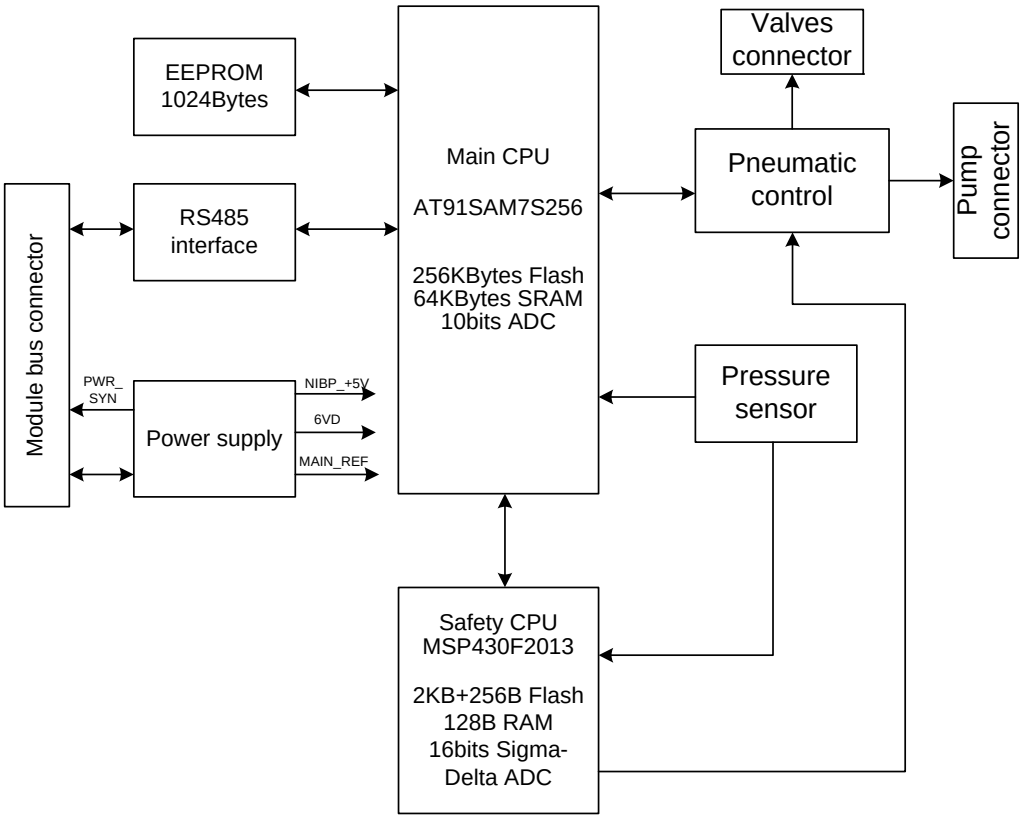


Figure 10 NIBP board functional block diagram

Signal processing

Two signals from the pressure transducers are amplified and sent to the A/D converter. After the converter, digitized signals are sent to the microprocessor for data processing.

The NIBP board is controlled with an ARM7 microprocessor at 16 MHz oscillator frequency.

Memory

The NIBP program memory (processor flash memory) size is 256k x 8. The processor has 64 kBytes RAM. The EEPROM size is 8K x 8 and it is used to store the calibration values for the pressure transducers, the pulse valve constants gained during measurements, the PC board identification, and the module serial number.

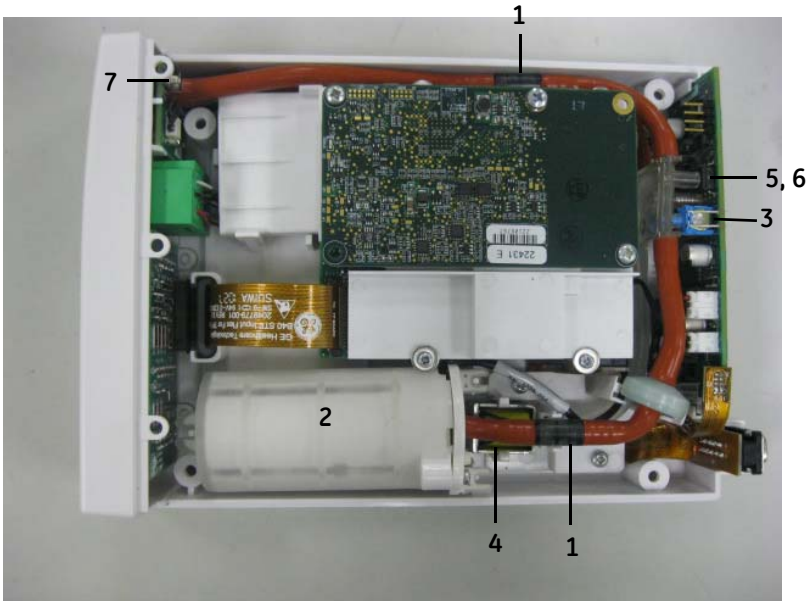
Software control

The software controls valves and a pump. In addition to the individual on/off signals for each component there is a common power switch for the valves and the pump that can be used at pump/valve failures.

Safety circuit

The NIBP board is equipped with an independent safety circuit to disconnect supply voltages from the pump and the valves if the cuff has been pressurized longer than the preset maximum measurement time, or if the pressure of the cuff is inflated over the specified pressure limit. The maximum measurement time values and pressure limits for different measurement modes have been specified in the technical specification section of this manual.

Pneumatics



The module has the following pneumatics parts:

1. **Intake air filter**; for preventing dust and other parts from entering the air pump and the valves.
2. **Air pump**; for pumping the measuring pressure of the cuff.
3. **Deflation Valve**; for producing a linear pressure fall (bleeding) in order to measure the blood pressure of the patient.

4. **Safety valve/Dump valve**; The Safety valve/Dump valve is intended to be used for deflating the cuff in single fault case, i.e. to prevent too long a measurement time or too high an inflation pressure of the cuff.
5. **Main pressure sensor**; for measuring the pressure of the blood pressure cuff and the pressure fluctuations caused by arterial wall movement.
6. **Second pressure sensor;** for detecting the, cuff loose, cuff occlusion situations, etc. and for recognizing the pressure sensor fault.
7. **Cuff connector;** for connection and hose identification.

Power supply section of the NIBP board

All connections are established via a 10-pin connector (male). The module needs a +15 V (dirty) power supply to operate. The supply voltage Vmod 15V +/- 3% is generated in the power supply section of the monitor. The other voltages needed for the operation of the NIBP measurement are made on the NIBP board.

The NIBP power supply synchronizes the ECG and STP isolation power and supplies non-isolated 5 V to the ECG and STP board.

4.2.3 ECG board in 5-lead measurement

The ECG measurement consists of the functions shown in Figure 11. All functions are located in the ECG board except the ECG input unit.

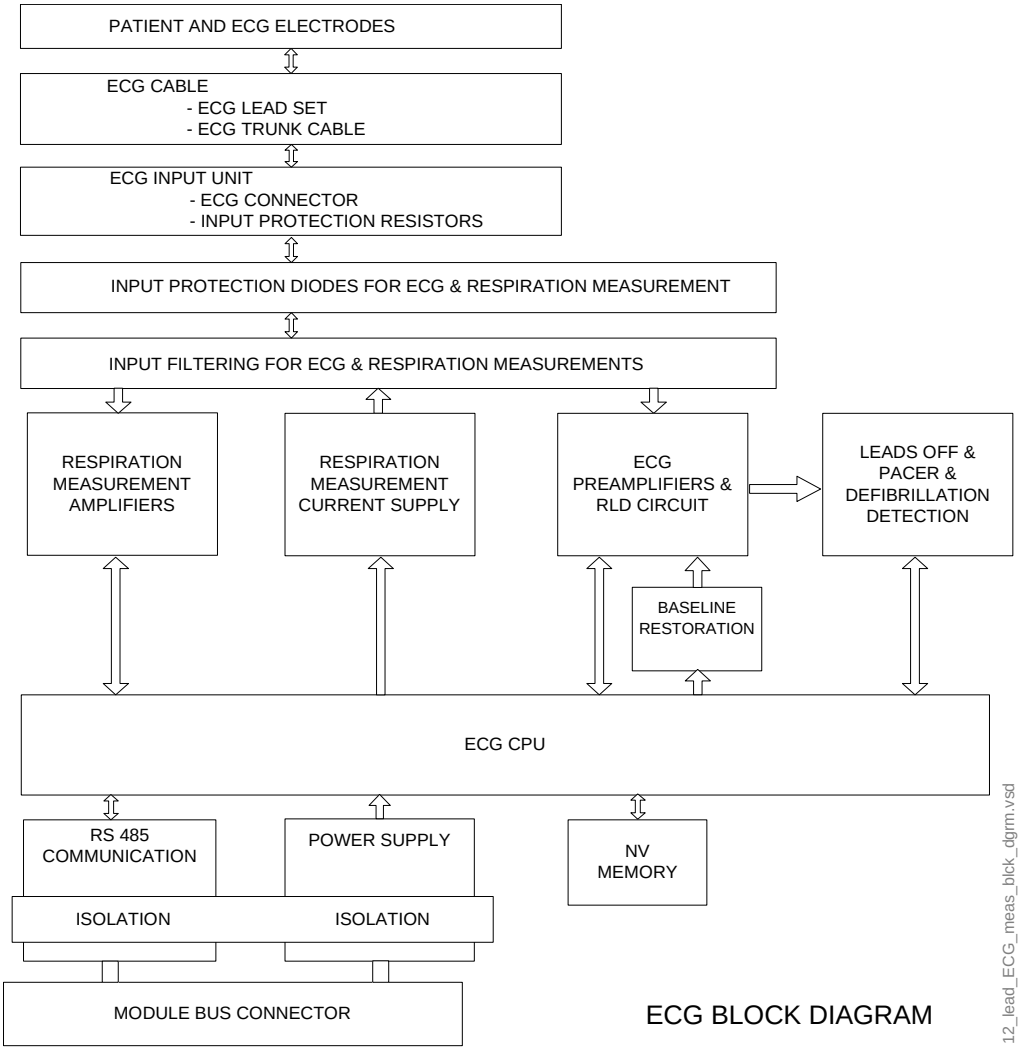


Figure 11 ECG measurement block diagram

ECG input unit

The ECG input unit consists of the front panel connector and the ECG input connector board with the high voltage protection resistors. The connector for the ECG cable is a green 11-pin rectangle shaped connector.

Input protection and filtering

The input protection is implemented with high voltage protection resistors in the ECG input unit and with protection diodes in the ECG board. The input filtering for ECG measurement is done with passive RC filtering.

ECG preamplifiers

The buffer amplifiers are used for each lead. The “Leads off” detection is implemented by measuring the output level of the input buffer amplifiers with the A/D converter of the CPU. The ECG signals are measured using differential amplifiers.

ECG amplifiers and baseline restoration

The function of the ECG amplifiers and baseline restoration is to amplify the signal and to restore the baseline of the signal in the middle of the display after the change of the signal level, e.g. after the change of the DC offset voltage.

Pacemaker detection

Pacer detection has been made by using four slew rate detector circuits. The pacer detection amplifiers have been realized at the front of the slew rate detectors independently of the ECG measuring channels.

Respiration impedance supply

The 31.25 kHz sine wave generator is used as the respiration measurement signal supply. Analog switches are used for connecting the sine wave to the ECG leads to be measured.

Respiration impedance amplifiers

Buffer amplifiers are used in respiration measurement. Analog switches are used for selecting the measurement leads. There are also additional amplifiers for increasing the respiration signal gain. When ECG measurement is 5-lead, the respiration measurement is always done between R and F, independently on the ECG lead selection. When ECG measurement is 3-lead, then the respiration measurement is happened at the same lead as the ECG measurement (I, II or III).

ECG CPU

The CPU is a 16 bit H8/3052 single-chip microcomputer. It contains 128 kbytes of flash memory and 4 kbytes of RAM. The clock frequency is 16 MHz.

RS485 communication

The communication to the CPU board of the monitor uses RS485 protocol. The RS485 driver circuits are optically isolated from the processor of the module.

Power supply

The ECG board has a driver-controlled half-bridge switching power supply with 5 kV isolation. The supply voltages have been regulated with linear regulators.

4.2.4 ECG filtering

B40/B20 monitors have three ECG filtering modes:

MONITORING	0.5 to 40 Hz
DIAGNOSTIC	0.05 to 150 Hz
ST FILTER	0.05 to 40 Hz

The purpose of filtering is to reduce high frequency noise and low frequency (e.g. respiratory) movement artifacts.

The monitor filter is used in normal monitoring. The diagnostic filter is used if more accurate diagnostic information is needed. The ST filter gives more accurate information of ST segment, but reduces high frequency noise.

The high-pass filters 0.5 Hz and 0.05 Hz are done with software. The monitor sends a command to the hemodynamic module determining which of the corner frequencies 0.5 Hz or 0.05 Hz is to be used.

The 50 Hz and 60 Hz reject filters are both low-pass filters with zero at 50 Hz or 60 Hz correspondingly. They are software based filters used for the mains supply filtering.

In diagnostic mode the upper frequency is 150 Hz and it is limited by software.

4.2.5 STP board

STP module measures SpO_2, two channels of temperatures and two channels of invasive blood pressures.

The SpO_2 measurement is made optically with an infrared light, a red light sources, and a photosensitive detector. The SpO_2 value and Pulse Rate are calculated based on the signals, which are measured with the photosensitive detector in the SpO_2 sensor. There are three configurations of SpO_2: GE SpO_2, Masimo SpO_2 and Nellcor SpO_2. There are four kinds of STP parameter board:

- GE SpO_2 board
- STP board, integrated GE SpO_2, Temperature and pressure
- TP board, integrated Temperature and pressure, communicated with Masimo OEM SpO_2 through UART port to get SpO_2 data and send to host.
- TP board, integrated Temperature and pressure, communicated with Nellcor OEM SpO_2 through UART port to get SpO_2 data and send to host.

The temperature measurement is designed for use with YSI-400 series NTC sensors.

The Invasive Pressure measurement is designed for use with the bridge type medical pressure sensors.

Refer to the following block diagram.

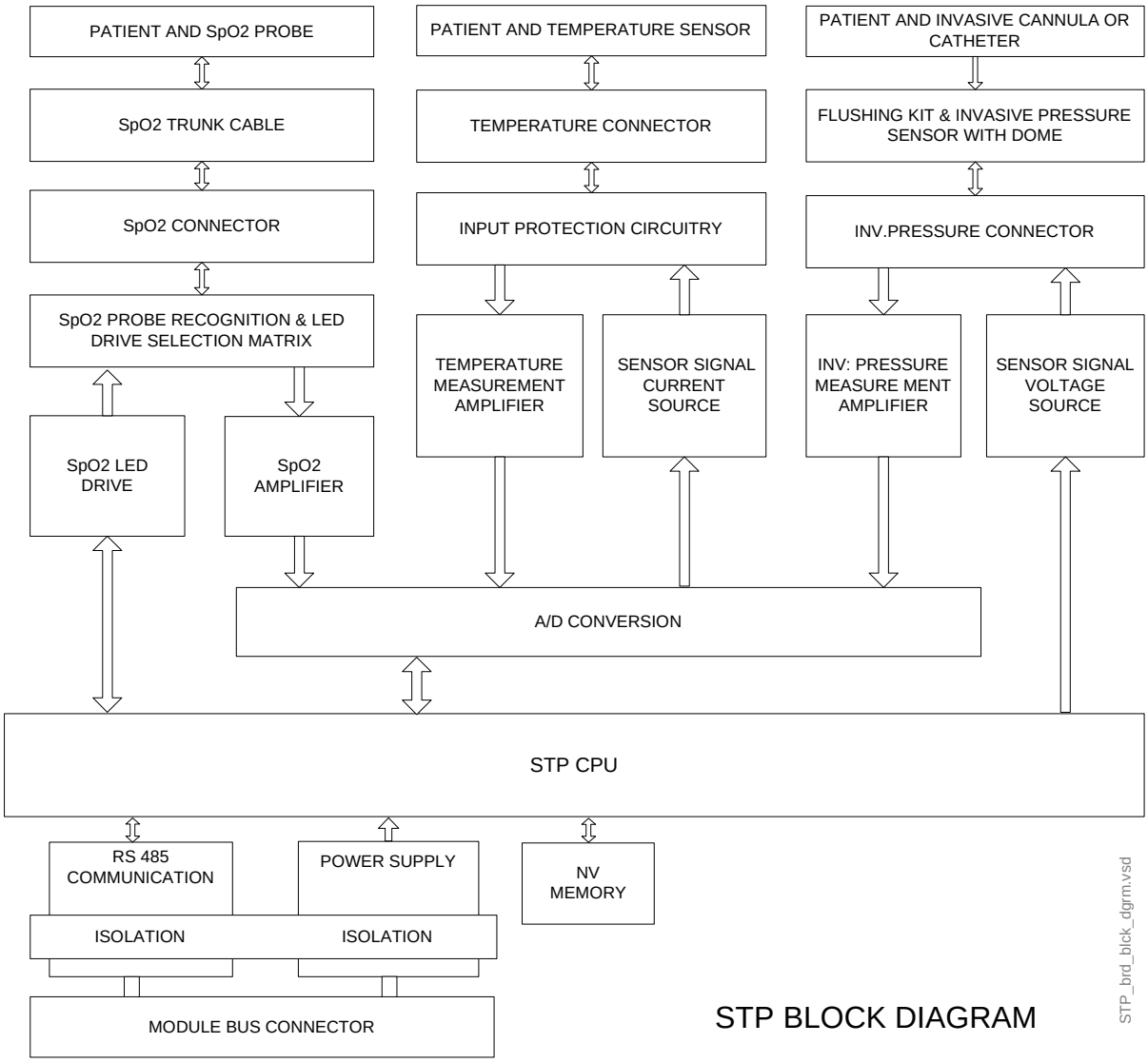


Figure 12 STP block diagram

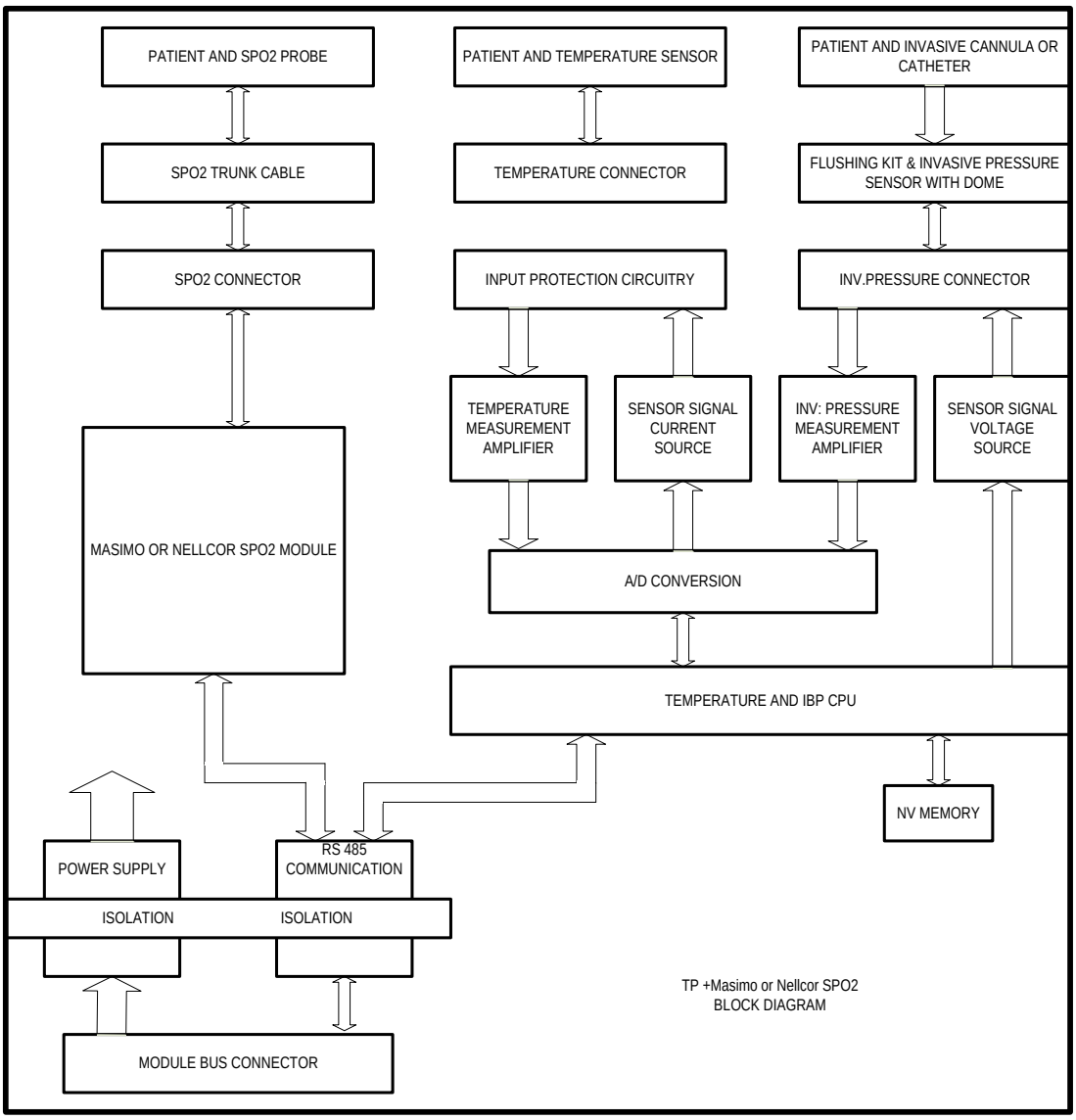


Figure 13 TP board block diagram

Microprocessor unit

The CPU is a 16 bit H8/3052 single-chip microcomputer. It contains 128 kbytes of flash memory and 4 kbytes of RAM. The clock frequency is 16 MHz.

High speed I/O is used to obtain a pulse control sequence necessary for pulse oximetry measurement. Timing for the clock is from the oscillator.

Temperature measurement unit

The NTC-resistor value in the probe depends on the patient's temperature. It is measured with the following principle described below.

The constant current source is supplied about 38 μA current through the temperature sensor (YSI 400-series NTC resistor). The constant current is caused a voltage over the temperature sensor (NTC resistor). The voltage over the temperature sensor is amplified in a differential amplifier stage. The amplified voltage is transferred to a controller of the STP board through an A/D converter.

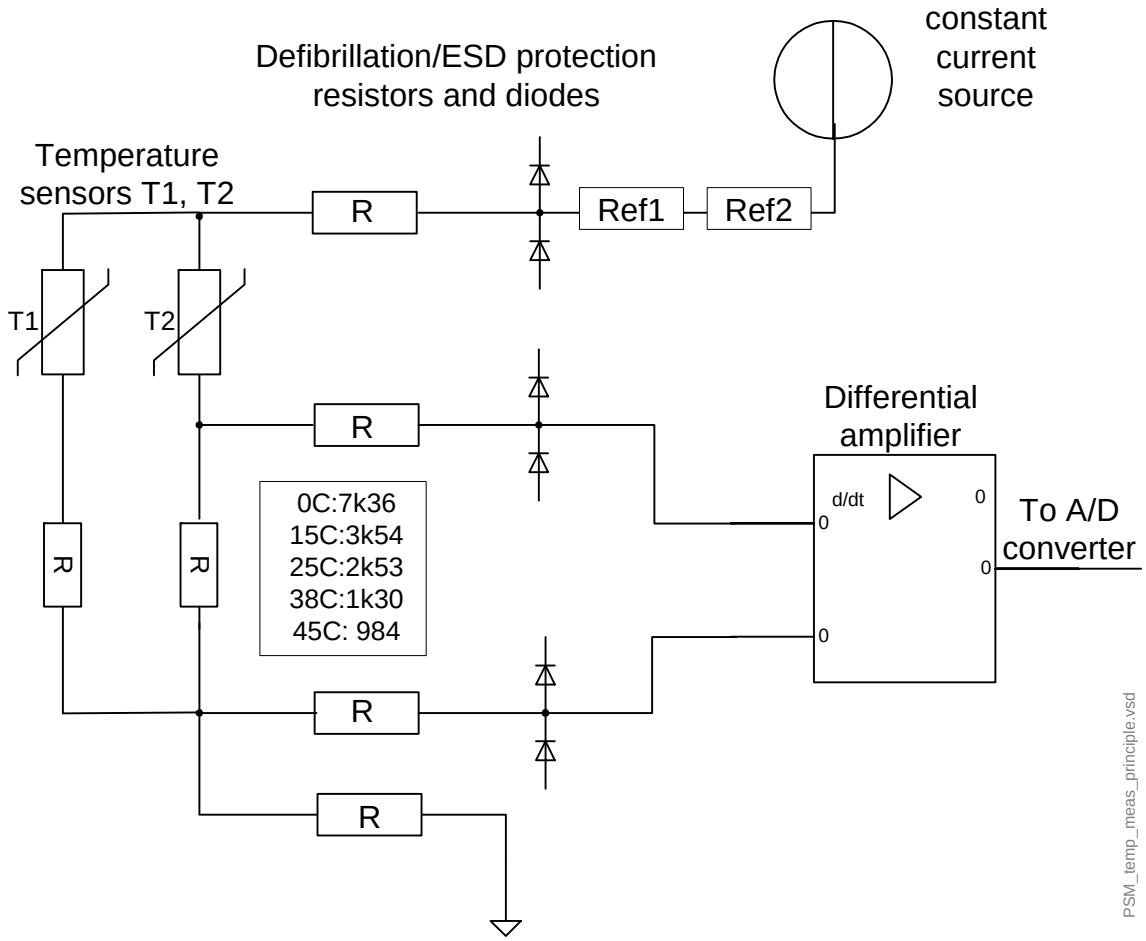


Figure 14 Temperature measurement principle

Invasive blood pressure measurement unit

An isolated +5 V voltage is supplied to the pressure transducer. The differential voltage, which depends on the pressure and the supplied voltage, is calculated from the bridge connection (see the formula below).

$U_{out} = U_{in} \times \text{pressure} \times 5\ \mu V$, where U_{in} is 5 V

$\Rightarrow U_{out} = 25\ \mu V \times \text{pressure [mmHg]}$

Pressure amplification is realized in the instrumentation amplifier. The gain of the amplifier is set to keep the level of the signal transferred to the A/D converter within the measurement range even when there are circumstantial offsets or offsets caused by the transducer. There is a filter before the amplifier to attenuate high frequency disturbances.

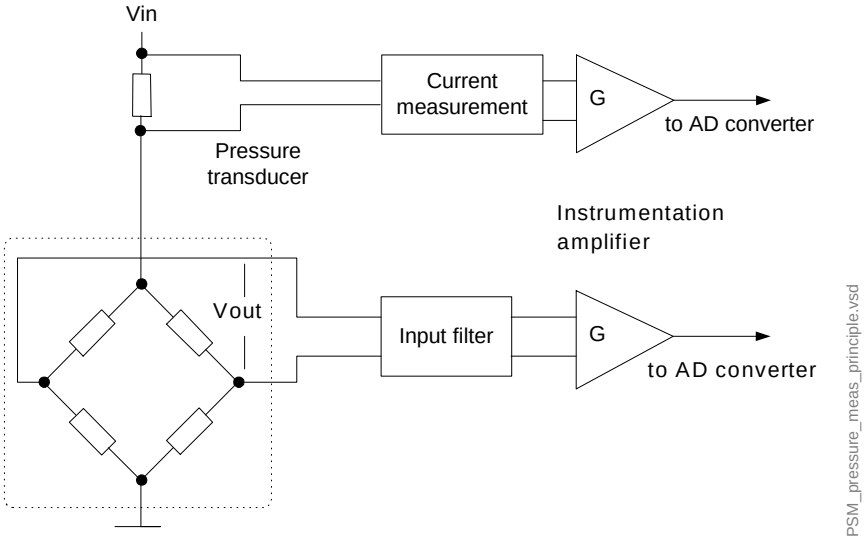


Figure 15 Pressure measurement principle

Pulse oximetry measurement section

LED control signals

The D/A converters of the microcontroller on the STP board set the LED intensity adjustment values for the infrared and red LEDs of the SpO_2 probe. The microcontroller on the STP board switches ON (to the adjusted intensity) and OFF the SpO_2 probe LEDs according to the predetermined sequence.

LED driving circuit

Differential amplifiers measure the LED currents (LED current indication) of the SpO_2 probe over the shunt resistors placed in the LED current paths. The LED driving voltages (LED voltage indication) are measured from the driver circuitry. The LED driving circuits also have MOSFET transistor matrix to enable the use of different probe configurations.

Measured signal preamplification

The preamplifier is a bipolar/single-ended current-to-voltage converter with adjustable gain. A higher gain is used for measuring thin tissue. The preamplification stage has also ambient light reduction and a second amplifier stage.

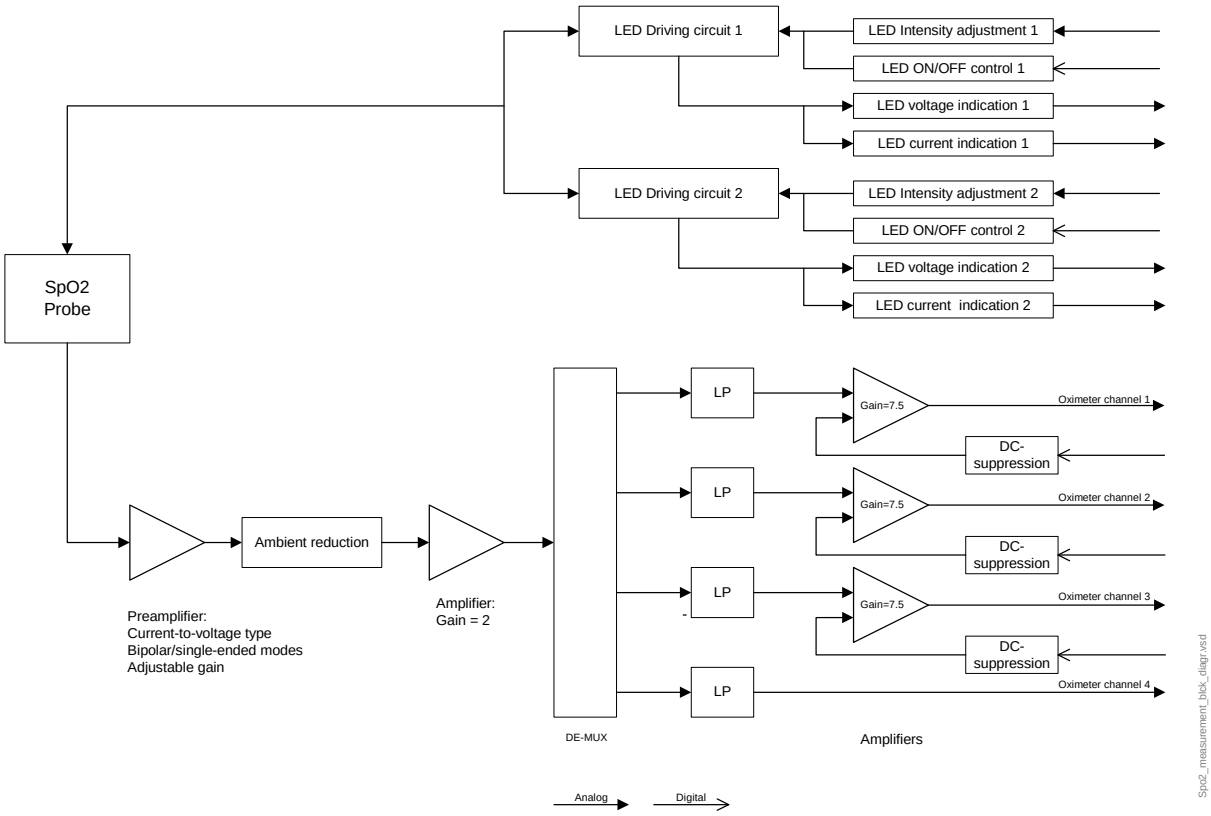


Figure 16 GE Pulse oximetry measurement block diagram

Red and infrared channel separation

It is possible to multiplex the detector signal to four different channels depending on the content of the signal. The detector signal must at least multiplex into infrared and red signals. Other channels are e.g. for diagnostic purposes.

4.2.6 Power supply

Serial communication

An RS485 type bus driver makes the serial communication between the module and the frame. The data transmission rate is 500kbps.

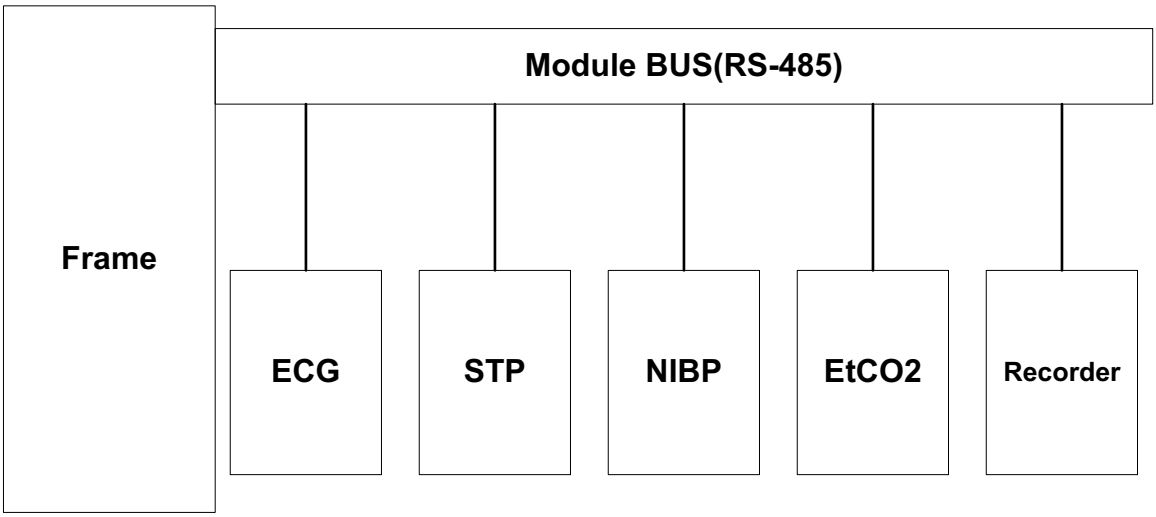


Figure 17 Serial communication between Frame and modules

Signals and isolation barrier

The communication signals transfer over the isolation barrier by using high isolation voltage (6kV) opto isolators.

Power supply section

The power for the electronics on the floating part of the STP and the ECG boards is made on each board with the switching power supplies connected to a high voltage isolated transformer. The switching power supplies on the STP and ECG boards are synchronized to the frequency, about 172.8 kHz of the switching power supply on the NIBP board. The NIBP board supplies non-isolated 5 V to the ECG and STP boards. The module uses only Vmod 15V +/- 3% of the frame. The other voltages of the measuring boards are made by the switching power supplies and regulators or the linear regulators. Each measuring board is protected against overloading with PTC type automatic fuses.

4.3 Connectors and signals

4.3.1 Front panel connectors

Table 6 ECG connector

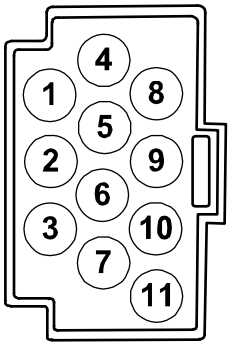
ECG Connector	Pin No.	Signal Name
	1 2 3 4 5 6 7 8 9 10 11	R/RA; Right arm electrode C2/V2; Chest electrode C3/V3; Chest electrode L/LA; Left arm electrode N/RL; Neutral/Right Leg Drive electrode C1/V1; Chest electrode C4/V4; Chest electrode F/LL; Left Leg electrode C6/V6; Chest electrode C5/V5; Chest electrode Cable Shield

Table 7 SpO_2 connector

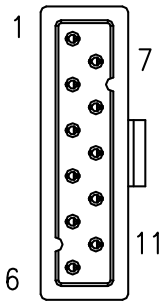
SpO_2 connector	Pin No.	Signal	Description
	1	DET_A	Photodiode anode
	2	DET_C	Photodiode cathode
	3	DATA-	
	4	Wire 1/3	LED connection
	5	IR_C	IR LED cathode
	6	OUTER SHIELD	
	7	DET_SHIELD	
	8	PRB_ID	Bin/ID Resistor+
	9	Wire 3/5	LED Connection
	10	RED_C	RED LED cathode
	11	DATA+	

Table 8 Invasive blood pressure connectors (IBP1, IBP2)

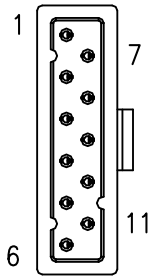
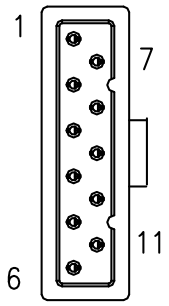
Invasive blood pressure connectors (Dual BP)	Pin No.	Signal	Description
	1	BP_+V_{REF}	BP transducer excitation voltage, channel 1
	2	BP SIG+	BP transducer signal positive (+), channel 1
	3	BP_+V_{REF}	BP transducer excitation voltage, channel 2
	4	AGND	Analog ground
	5	BP SIG+	BP transducer signal positive (+), channel 2
	6	SHIELD	BP cable shield
	7	AGND	Analog ground
	8	BP SIG1	BP transducer signal negative (-), channel 1
	9	BP SIG2	BP transducer signal negative (-), channel 2
	10	BP1_ID	BP1 probe identification
	11	NC	Not connected

Table 9 Temp connector (T1, T2)

Temp connector	Pin No	Signal
	1	Sensor drive current
	2	Input from temperature sensor, channel 1
	3	Not connected
	4	Not connected
	5	Thermistor ID (LOW= Temperature error, HIGH=YSI 400 series)
	6	Cable shield
	7	Analog ground
	8	Input from temperature sensor, channel 2
	9	Not connected
	10	Not connected
	11	Digital ground

4.4 Measurement principle

4.4.1 NIBP

NIBP (Non-Invasive Blood Pressure) is an indirect method for measuring blood pressure.

The NIBP parameter conforms to EN1060-1:1995/A2:2009 Specification for Non-invasive sphygmomanometers.

The NIBP measurement is performed according to the oscillometric measuring principle. The cuff is inflated with a pressure slightly higher than the presumed systolic pressure, and deflated at a speed based on the patient's pulse, collecting data from the oscillations caused by the pulsating artery. Based on these oscillations, values for systolic, mean, and diastolic pressures are calculated.

The following parts are necessary for the NIBP measurement:

- hemo module
- twin hose (adult or infant model)
- blood pressure cuffs (various sizes)

4.4.2 ECG

Electrocardiography analyzes the electrical activity of the heart by measuring the electrical potential produced with electrodes placed on the surface of the body.

ECG reflects:

- electrical activity of the heart
- normal/abnormal function of the heart
- effects of anesthesia on heart function
- effects of surgery on heart function

See the "User's Guide" or the "User's Reference Manual" for electrodes' positions and other information.

4.4.3 Pulse oximetry

A pulse oximeter measures the light absorption of blood at two wavelengths, one in the near infrared (about 940 nm) and the other in the red region (about 660 nm) of the light spectrum. These wavelengths are emitted by LEDs in the SpO_2 probe, the light is transmitted through peripheral tissue and is finally detected by a PIN-diode opposite the LEDs in the probe. The pulse oximeter derives the oxygen saturation (SpO_2) using an empirically determined relationship between the relative absorption at the two wavelengths and the arterial oxygen saturation SaO_2.

In order to measure the arterial saturation accurately, pulse oximeters use the component of light absorption giving variations synchronous with heart beat as primary information on the arterial saturation.

A general limitation of pulse oximetry is that due to the use of only two wavelengths, only two hemoglobin species can be discriminated by the measurement.

The modern pulse oximeters are empirically calibrated either against fractional saturation SaO_2frac;

$$SaO_2frac = \frac{HbO_2}{HbO_2 + Hb + Dyshemoglobin}$$ Formula 1

or against functional saturation SaO_2func;

$$SaO_2func = \frac{HbO_2}{HbO_2 + Hb}$$ Formula 2

Functional saturation is more insensitive to changes of carboxyhemoglobin and methemoglobin concentrations in blood.

The oxygen saturation percentage SpO_2 measured by the Datex-Ohmeda module is calibrated against functional saturation SaO_2func. The advantage of this method is that the accuracy of SpO_2 measurement relative to SaO_2func can be maintained even at rather high concentrations of carboxyhemoglobin in blood. Independent of the calibration method, pulse oximeters are not able to correctly measure oxygen content of the arterial blood at elevated carboxyhemoglobin or methemoglobin levels.

Plethysmographic pulse wave

The plethysmographic waveform is derived from the IR signal and reflects the blood pulsation at the measuring site. Thus the amplitude of the waveform represents the perfusion.

Pulse rate

The pulse rate calculation is done by peak detection of the plethysmographic pulse wave. The signals are filtered to reduce noise and checked to separate artifacts.

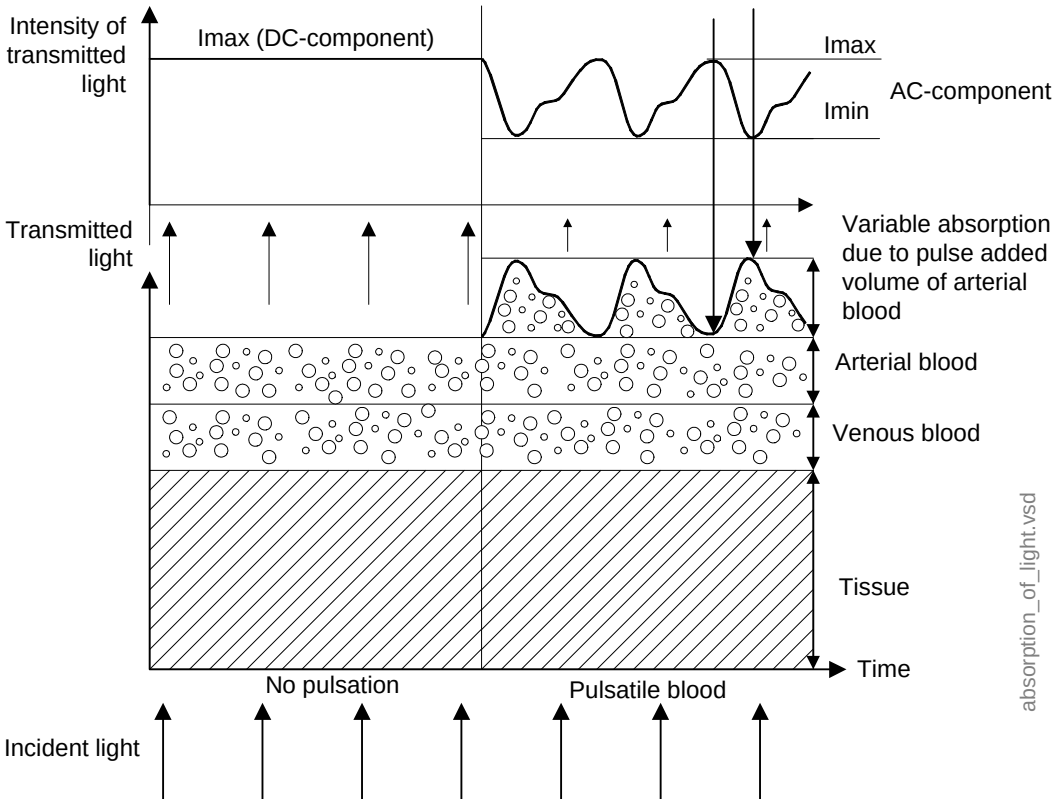


Figure 18 Absorption of infrared light in the finger

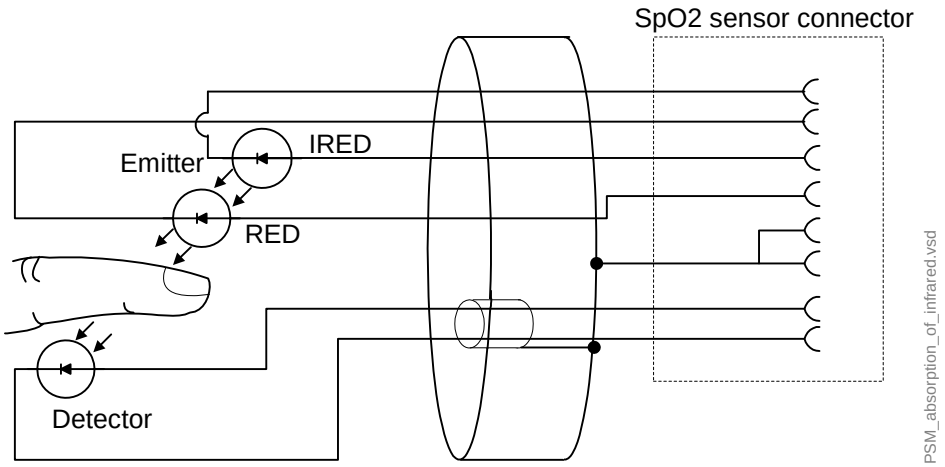


Figure 19 Pulse oximetry probe parts layout and schematic diagram

The standard probe is a finger clamp probe which contains the light source LEDs in one half and the photodiode detector in the other half. Different kinds of probes are available from GE Healthcare.

4.4.4 Temperature

The temperature is measured by a probe whose resistance varies when the temperature changes, called NTC (Negative Temperature Coefficient) resistor.

The resistance can be measured by two complementary methods:

- Applying a constant voltage across the resistor and measuring the current that flows through it.
- Applying a constant current through the resistor and measuring the voltage that is generated across it.

Hemo module uses the constant current method. The NTC-resistor is connected in series with a normal resistor and a constant current is applied through them. The temperature dependent voltage can be detected at the junction of the resistors, thus producing the temperature signal from the patient. The signal is amplified by analog amplifiers and further processed by digital electronics.

4.4.5 Invasive blood pressure

To measure invasive blood pressure, a catheter is inserted into an artery or vein. The invasive pressure setup, consisting of a connecting tubing, a pressure transducer, an intravenous bag of normal saline, all connected together by stopcocks, is attached to the catheter. The transducer is placed at the same level with the heart, and is electrically zeroed.

The transducer is a piezo-resistive device that converts the pressure signal to a voltage. The monitor interprets the voltage signal so that pressure data and pressure waveforms can be displayed.

4.4.6 Respiration

Impedance respiration is measured across the thorax between ECG electrodes. The respiration signal is made by supplying current between the electrodes and by measuring the differential current from the electrodes. The signal measured is the impedance change caused by breathing. The respiration rate is calculated from these impedance changes, and the respiration waveform is displayed on the screen.

2 Hardware installation

1 Hardware installation

Safety precautions

Warnings

- The monitor or its components should not be used adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, the monitor and its components should be observed to verify normal operation in the configuration in which it will be used.
- After transferring or reinstalling the monitor, always check that it is properly connected and all parts are securely attached. Pay special attention to this in case of stacked mounting.
- The monitor must not be used without a manufacturer approved mounting attached.
- Never install the monitor so that it is above the patient.

Cautions

- The monitor display is fragile. Ensure that it is not placed near a heat source or exposed to mechanical shocks, pressure, moisture or direct sunlight.

1.1 Unpacking instructions

1. Confirm that the packing box is undamaged. If the box is damaged, contact the shipper.
2. Open the top of the box and carefully unpack all components.
3. Confirm that all components are undamaged. If any of the components is damaged, contact the shipper.
4. Confirm that all components are included. If any of the components is missing, contact your GE Healthcare distributor.

1.2 Choosing location

Consider the following aspects:

- lighting
- space
- connections
- electromagnetic and radio frequency interference. For details see Appendix B. ElectroMagnetic Compatibility
- environment

1.3 Mounting the monitor

Mounting of monitor to the Wall Mount, Rollstand, Wall Mount with standard arm or Counter Top Mount is described in a separate instruction sheet delivered with each mount.

1.4 Connection to mains

Connect the power cord to the mains power inlet at the back of the monitor and to the wall socket.

NOTE: Before taking the monitor into use for the first time, the batteries should be fully charged. Keep the monitor connected to the mains until the Battery charging symbol disappears (may take up to 5 hours if the batteries are fully discharged).

Battery charging symbol

WARNING **The power cord may only be connected to a three-wire, grounded, hospital grade receptacle**

1.4.1 Install the batteries

1. Open the lid of the battery compartment by the side of the monitor. Move the latch up or down.
2. Put in the new battery. Make sure that the charging indicator is facing to the back side of the monitor, then push the battery in all the way, move the latch and close the lid. Power on the monitor, check the monitor indicators, see above.

1.5 Connection to Network

WARNING **Do not use with iCentral software V5.0.2 and earlier or Mobile Care Server software earlier of V5.2.**

The B40/B20 monitor has been verified to be able to work in CARESCAPE™ Network and S/5 network environments. Other network infrastructures are not supported.

The B40/B20 monitor has the capability to communicate with GE CARESCAPE pro CIC version 4.0.8, 4.1.1 and 5.1.0; communication with iCentral version 5.0.3 and 5.1.1.

The B40/B20 monitor can talk to Aware Gateway Server V1.6 in Unity network and talk to Mobile Care Server V5.2 in S/5 network. The B40/B20 monitor can work with S/5 Collect V4.0.

The B40/B20 monitor can talk to at most 4 CIC Central Stations, 1 Aware Gateway Server and 1000 other devices simultaneously in one CARESCAPE MC network. The CIC that performs the Full-Disclosure must be one of the first 4 CICs.

The monitor can't act as the Time Master in Unity network.

The B40/B20 monitor does not support Patient Data Server; B40/B20 realtime patient data can't be viewed on other monitors (e.g. Dash 3000/4000/5000, Solar 8000, B850, B650) except unit name, bed name and alarm message.

1.5.1 Pre-installation requirements

Ensure that the applicable network infrastructure is in place prior to the installation of the patient monitor.

Acquire the network configuration information from the hospital IT or the related project documentation and installation files.

MC Network

- The MC Network infrastructure shall be installed according to the "CARESCAPE Network Configuration Guide".
- The installation site of the patient monitor shall have a wall jack and a network patch cable for the MC Network.

S/5 Network

- The S/5 Network shall be installed according to the "S/5 Network Installation Guide". Refer to the "iCentral and iCentral Client Service Manual" for iCentral installation instructions.
- The installation site of the patient monitor shall have a wall jack and a network patch cable for the S/5 Network.

To connect the network

Use the CAT-5 network cable to connect the monitor to the network.

1. Make sure that the power is switched off.
2. Connect the one RJ-45 connector to network port at the back of the monitor.
3. Connect the other RJ-45 connector to the corresponding port on the wallbox.
4. Power on the monitor and set up the network configuraiton (refer to 1.5.2. Network configuration).
5. Confirm that the network symbol and 'Connected to Network' message are displayed in the upper part of the screen.

1.5.2 Network configuration

How to set up Unity network

1. Connect network cable to the ethernet port on the rear of the monitor. Connect the other end of the cable to the clinical network.
2. Enter the service mode in the monitor:

   Monitor Setup

   Install/Service (16-4-34)

   Service (26-23-8)
3. Select the network mode:

   Frame (in service menu)

   Network

   Network

   Choose "***Unity***" as network mode
4. Set up Unity configuration

   Unity config

   Set up following information:

- Unit Name:
  It is used for setting the unit name in the monitor. The default unit name is "X".
  NOTE: Unit Name here should be set to be same as CIC Unit Name.
- Bed Name:
  It is used for setting the bed name in the monitor. The default bed name is the last five characters of the MAC address, excluding the colon delimiter characters.
- Save Changes:
  It is gray if the changes have not been done to the menu information.
  NOTE: When save changes the monitor will restart automatically.

5. Set up the TCP/IP configuration

   TCP/IP Config

   TCP/IP Config

   - Configure the monitor's IP address, subnet mask, default gateway.
     NOTE: If the IP address or both of unit name and bed name duplicate, the alarm will be given to the new added monitors.
   - Save the configuration after configuring the TCP/IP. When save changes the monitor will restart automatically.

WARNING **If only B40/B20 monitors and Dash monitors in the Unity network, do not set up B40/B20 monitors with the highest IP address. For this may cause the Unity time sync function can't work with Dash monitors.**

6. If the monitor does not connect to network correctly, you may also need to set up the speed and duplex configuration.

   TCP/IP Config

   TCP/IP Config

   Speed and Duplex

   Choose the suitable settings according to your network environment. The default setting is ***AUTO***.

How to set up S/5 network

1. Connect network cable to the ethernet port on the rear of the monitor. Connect the other end of the cable to the clinical network.
2. Enter the service mode in the monitor:

   Monitor Setup

   Install/Service (16-4-34)

   Service (26-23-8)
3. Select the network mode:

   Frame (in service menu)

   Network

   Network

   Choose "***S5***" as network mode
4. Setup S/5 network configuration

   Dri config

   Set up following information:

- DRI level:
  It is used for setting the monitor's network communication. should be selected to 2003
- Virtual Plug ID:
  Should enter 5 digit numbers, which is the same as in iCentral.
  NOTE: If you don't have the virtual plug ID number in iCentral, please refer to the "iCentral User's Reference Manual" to set up in iCentral first.
- Transfer Mode:
  It is used for choosing transfer mode: DRI/ETH or DRI/UDP
  Should be selected to DRI/ETH
- Software Download:
  Reserved for future use.
- Save Changes:
  Select "Save Changes" to take in use changes made in this page.

NOTE: In S/5 network protocol, no need to set up the TCP/IP settings.

NOTE: For other the network menu's instruction, please refer to 3.2. Network in "Service Menu" chapter for more details.

1.6 Inserting and removing the E-miniC module

To use the E-miniC module, your monitor need pre-configure the extension rack from manufacture.

To insert module:

1. Align the module with the insertion guides
2. Push the module into the monitor frame until it clicks and stops.
3. Pull the module outwards to insure the module is firmly seated.

To remove module:

1. Pressing the release latch, on the bottom of the module.
2. Grasp the module firmly and pull out of the Frame. Make sure not to drop it when it comes out.

WARNING **When detaching modules, be careful not to drop them. Always support with one hand while pulling out with the other.**

1.7 Monitor connections

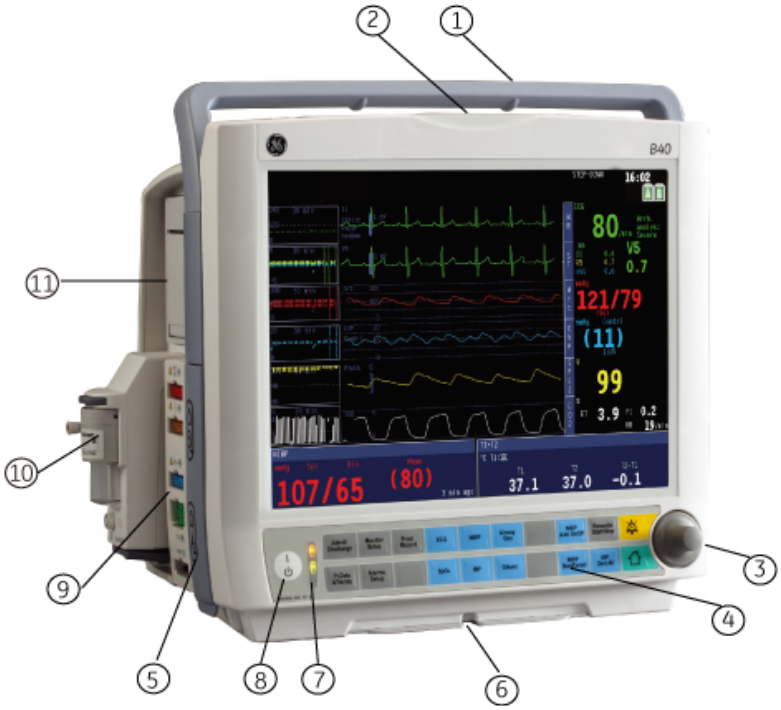


Figure 3 Font view

(1) Transportation handle
(2) Alarm light
(3) The Trim Knob
(4) Keyboard/membrane switch
(5) Battery compartment
(6) Guide rail for GCX mounting
(7) Mains power and battery LEDs
(8) On/standby key
(9) Hemo connectors
(10) E-miniC module
(11) Recorder module

Figure 4 Rear view connections

(1) Receptacle for power cord
(2) Serial port
(3) Defibrillator connector
(4) Nurse call connector
(5) Network connector
(6) Equipotential connector
(7) Multi I/O connector

NOTE: The Multi I/O with ports 2,3,4 are optional parts for customer.

1.8 Visual indicators

Function	Specification	Explanation
External power supply	Green LED	Indicates when monitor is powered from mains
Battery operation	Green LED	Indicates when monitor is powered from internal batteries
Battery condition	Orange LED	Indicates when monitor is charging batteries (solid) or battery failure (flashing).
Alarm Light	Highly visible Red/Yellow/Cyan light	Ease alarm detection from distance.

1.9 Installation checkout

Refer to the 3. Installation checkout in Chapter 3 for procedure.

3 Maintenance

1 Instructions

1.1 Introduction

These instructions include procedures of system maintenance for the B40/B20. It's include four sections:

- Electrical safety tests.
- Installation checkout, which should be performed after installation and service configuration.
- Maintenance and checkout, which should be performed every 12 months.
- Adjustments and calibrations

NOTE: Please complete the check form when performing the corresponding procedures.

NOTE: For the E-MiniC maintenance and calibration, please refer to "8. E-MiniC Module" or "*S/5 Single-width Airway Module, E-miniC Technical Reference Manual Slot*" M1027829-1.

The symbol in the instructions means that the procedure performed should be signed in the check form.

The procedures should be performed in ascending order, bypassing those that are not applicable for a particular monitor.

To enter the service menus, you need following passwords:

Monitor Setup - *Install/Service* (password 16-4-34) **- *Service*** (password 26-23-8)

In case you evaluate the measurement accuracy with a patient simulator, add the simulator's accuracy specification to the one for the monitor.

CAUTION Failure on the part of all responsible individuals, hospitals or institutions, employing the use of this device, to implement the recommended maintenance schedule may cause equipment failure. The manufacturer does not, in any manner, assume the responsibility for performing the recommended maintenance schedule, unless an equipment maintenance agreement exists. The sole responsibility rests with the individuals, hospitals, or institutions utilizing the device.

CAUTION Only trained personnel with appropriate equipment should perform the tests and repairs outlined in this section. Unauthorized service may void warranty of the unit.

CAUTION Wear a static control wrist strap when handling PCB boards. Electrostatic discharge may damage components on the board.

1.2 Recommended tools

NOTE: Use only properly maintained, calibrated and traceable measurement equipment for the specified calibrations and adjustments to ensure accuracy.

NOTE: A functional tester cannot be used to assess the accuracy of pulse oximeter for monitor.

Table 1 Recommended accessories and tools

Accessories
A rigid cylinder or pipe
NIBP cuff
Adult NIBP cuff hose with cuff ID
Infant NIBP cuff hose with cuff ID
Tubing parts to connect a manometer and a pump to the NIPB cuff and hose.
Dual invasive pressure adapter cable
ECG accessories, IEC or AHA
- Multi-link 3-lead integrated cable and leadwire
- Multi-link 5-leadwire set
- Multi-link 3/5-lead ECG trunk cable
SpO_2 finger probe
SpO_2 Interconnect Cable
Temperature dual cable
CO_2 Sampling line 3m/10 ft
Tool
A multiparameter patient simulator with IBP, Temp adpter cables
Screwdrivers PH1, PH2

NOTE: For details on recommended accessories see “Supplies and Accessories“ catalog.

2 Electrical Safety Tests

2.1 General

Electrical safety tests provide a method of determining if potential electrical health hazards to the patient or operator of the device exist.

2.2 Recommendations

GE recommends that you perform all safety tests presented in this chapter.

- Upon receipt of the device (monitor and its associated equipment).
- Every twelve months thereafter planned maintenance
- Each time the main enclosure is disassembled or a circuit board is removed, tested, repaired, or replaced

These instructions are intended for every component in the system. GE recommends that the qualified personnel performing the tests.

2.3 Test Equipment

The recommended test equipment required to perform electrical safety tests is listed below.

Item	Specification
Satety Analyzer/Leakage Current Tester	Equivalent to the circuits shown
Ground Bond Tester	0 – 1 ohm
Safety Test Body Kit[a]	P/N M1155870 or equivalent

a Instead of the test bodies included in the safety test body kit, other applicable test bodies with all pins connected together may be used.

Perform electrical safety tests using an electrical safety analyzer per IEC 60601-1, UL 60601-1, EN 60601-1 or CSA C22.2 No. 601.1. The schematics in the section provide a general understanding of the test equipment. Actual configuration of test equipment may vary.

The patient monitor being tested should be placed on an insulating surface.

2.4 Power Outlet Test

Verify that the power outlet is wired correctly per the country's electrical code standard before starting the following electrical safety tests. The results of the following tests will be inaccurate unless a properly wired power outlet is used. Use only non-isolated power outlets when performing safety tests.

2.5 Power cord and plug

Verify the power cord being used with the patient monitor is good. The following are a couple of things to check for in this regard:

- Failure of the power cord strain relief is very common. Often times users of the equipment pull on the power cord itself, rather than the power cord plug, to unplug the patient monitor from a wall receptacle. If in doubt, test for continuity through each conductor of the power cord connector and plug.
- Verify line, neutral, and earth conductors are properly connected to the power cord plug and are not short-circuited. Replace the power cord, as necessary with a regulatory-approved cord for the country of use.

WARNING **Use only AC power cords recommended or manufactured by GE.**

2.6 Ground (Earth) Integrity

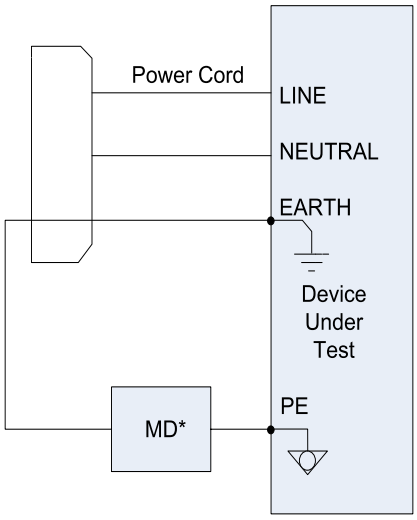
Listed below are two methods for checking the ground (earth) integrity, "Ground Continuity Test" and "Impedance of Protective Earth Connection." These tests determine whether the device's exposed metal and power inlet's earth (ground) connection has a power ground fault condition

Perform the in accordance with your local regulations.

Refer to the instructions contained with the safety analyzer to perform each test.

2.6.1 Ground Continuity Test

The measuring device (MD) in the diagram below may be a DMM or part of a safety analyzer.



NOTE: The measuring device (MD) represents the network and voltage measuring instrument and its frequency characteristics per IEC 60601-1.

Acceptance criteria:

- For equipment without a power supply cord, the impedance between the protective earth terminal and any accessible metal part which is protectively earthed shall not exceed 0.1 ohms.
- For equipment with a power supply cord, the impedance between the protective earth pin in the mains plug and any accessible metal part which is protectively earthed shall not exceed 0.2 ohms.

2.6.2 Impedance of Protective Earth Connection

This test, unlike a ground continuity test, will also stress the ground system by using special ground bond testers.

This test normally is only required as a manufacturing production test to receive safety agency compliance. Some country agencies do require this test after field equipment repairs (e.g., Germany's DIN VDE 0751 standards). Consult your country/local safety agency if in question.

Compliance is checked by the following steps:

(1) A current of 25A from a current source with a frequency of 50 or 60 Hz with a no-load voltage not exceeding 6 V is passed for at least 5 seconds, but no more than 10 seconds, through the protective earth terminal or the protective earth pin in the mains plug and each accessible metal part which could become live in case of failure in basic insulation.

(2) The voltage drop between the parts described is measured and the impedance determined from the current and voltage drop. It shall not exceed the values indicated.

When taking this measurement, move the unit's power cord around. There should be no fluctuations in resistance.

Acceptance criteria

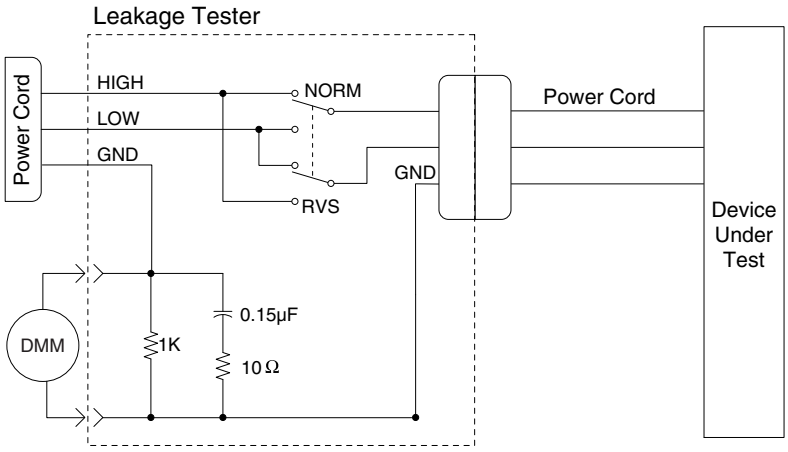
- For equipment without a power supply cord, the impedance between the protective earth terminal any accessible metal part which is protectively earthed shall not exceed 0.1 Ohms.
- For equipment with a power supply cord, the impedance between the protective earth pin in the mains plug and any accessible metal part which is protectively earthed shall not exceed 0.2 ohms.

2.7 Ground (earth) wire leakage current tests

This test measures the current leakage flowing from the mains part through or across the insulation into the protective earth conductor of the device under test.

Perform this test both in Normal Condition (NC) and in a Single Fault Condition (SFC), where one of the supply conductors is open at a time. Perform the test with normal and reverse polarity.

NOTE: Refer to the instructions delivered with the safety analyzer to perform this test.



DMM set to measure AC voltage

NOTE: The measuring device (MD) represents the network and voltage measuring instrument and its frequency characteristics per IEC 60601-1.

(1) Configure the safety analyzer as follows (NC):
- Polarity - NORMAL
- Neutral - CLOSED

(2) Power on the device under test.

(3) Read and record the current leakage indicated on the tester.

(4) Configure the safety analyzer as follows (SFC):
- Polarity - NORMAL
- Neutral - OPEN

(5) Read and record the current leakage indicated on the tester.

(6) Configure the safety analyzer as follows (SFC):
- Polarity - REVERSED
- Neutral - OPEN

(7) Read and record the current leakage indicated on the tester.

(8) Configure the safety analyzer as follows (NC):
- Polarity - REVERSED
- Neutral - CLOSED

(9) Read and record the current leakage indicated on the tester.

(10) Power off the device under test.

If measured reading is greater than the appropriate specification below, the device under test fails. Contact GE Technical Support.

Acceptance criteria NC (Normal condition)

- (USA only) 300 µA, and the device under test is powered from 100-120 V/50-60 Hz

- (USA only) 300 µA, and the device under test is powered from a center-tapped 200-240 V/50-60 Hz, single phase circuit (UL Split Phase Exemption)
- 500 µA, and the device under test is powered from a non-centertapped, 100-240 V/50-60 Hz, single-phase circuit

Acceptance criteria SFC (Single fault condition) - one of the supply conductors open at a time

- 1000 µA

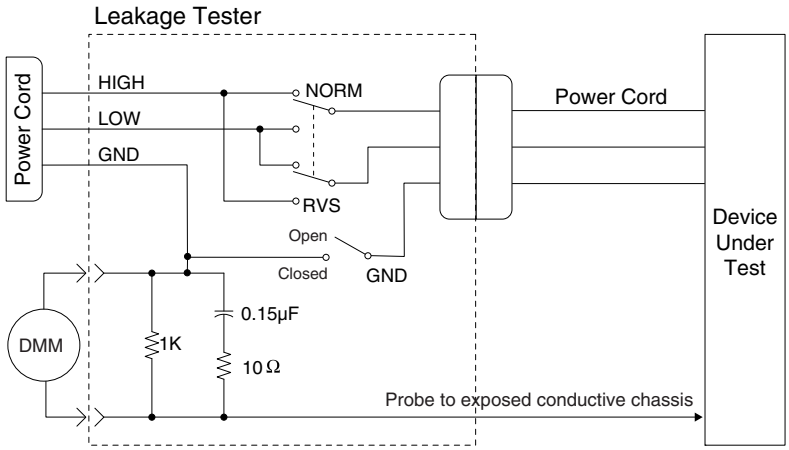
Center-tapped and non-center-tapped supply circuits produce different leakage currents and the UL and IEC limits are different.

2.8 Enclosure (Touch) leakage current test

This test measures current leakage through the exposed conductive parts on the device under test.

Perform the test in Normal Condition (NC) and in two different Single Fault Conditions (SFC): 1) earth open and 2) one of the supply conductors open at a time. Perform the test with normal and reverse polarity.

NOTE: Refer to the instructions delivered with the safety analyzer to perform this test.



DMM set to measure AC voltage

NOTE: The MD represents the network and voltage measuring instrument and its frequency characteristics per IEC 60601-1.

(1) Configure the safety analyzer as follows (NC):
   - Polarity - NORMAL
   - Neutral - CLOSED
   - GND (Earth) - CLOSED

(2) Power on device under test.

(3) Read and record the current leakage indicated on tester.

(4) Configure the safety analyzer as follows (SFC):
   - Polarity - NORMAL

- Neutral - OPEN
- GND (Earth) - CLOSED

(5) Read and record the current leakage indicated on the tester.

(6) Configure the safety analyzer as follows (SFC):

- Polarity - NORMAL
- Neutral - CLOSED
- GND (Earth) - OPEN

(7) Read and record the current leakage indicated on the tester.

(8) Configure the safety analyzer as follows (SFC):

- Polarity - REVERSED
- Neutral - CLOSED
- GND (Earth) - OPEN

(9) Read and record the current leakage indicated on the tester.

(10) Configure the safety analyzer as follows (SFC):

- Polarity - REVERSED
- Neutral - OPEN
- GND (Earth) - CLOSED

(11) Read and record the current leakage indicated on the tester.

(12) Configure the safety analyzer as follows (NC):

- Polarity - REVERSED
- Neutral - CLOSED
- GND (Earth) - CLOSED

(13) Read and record the current leakage indicated on the tester.

(14) Power off the device under test.

If measured reading is greater than the appropriate specification below, the device under test fails. Contact GE Technical Support.

Acceptance criteria NC

- 100 µA, and the device under test is powered from 100-240 V/50-60 Hz

Acceptance criteria SFC - earth open or one of the supply conductors open at a time

- (USA only) 300 µA, and the device under test is powered from 100-120 V/50-60 Hz
- (USA only) 300 µA, and the device under test is powered from a center-tapped 200-240 V/50-60 Hz, single phase circuit (UL Split Phase Exemption)
- 500 µA, and the device under test is powered from a non-centertapped, 110-240 V/50-60 Hz, single-phase circuit

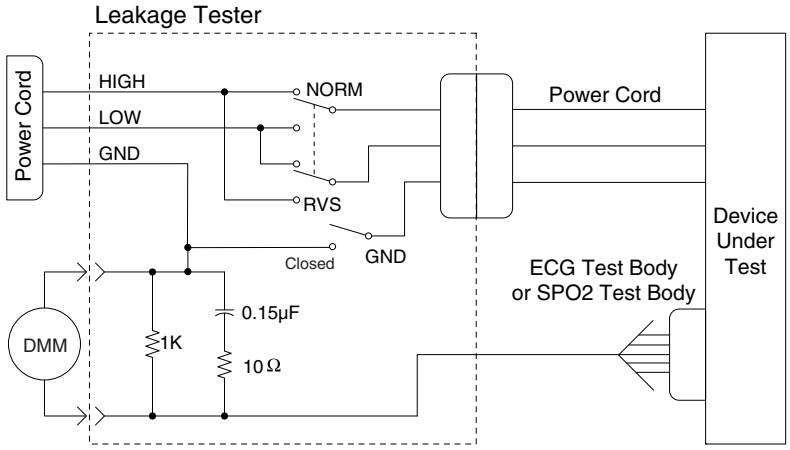
Center-tapped and non-center-tapped supply circuits produce different leakage currents and the UL and IEC limits are different.

2.9 Patient (source) leakage current test

This procedure measures the leakage current from the ECG/RESP connector or the SPO2 connector of the device to ground.

Use the safety test body kit to perform the test in Normal Condition (NC) and in two different Single Fault Conditions (SFC): 1) earth open and 2) one of the supply conductors open at a time. Perform test with normal and reverse polarity.

NOTE: Refer to the instructions delivered with the safety analyzer to perform this test.



DMM set to measure AC voltage

NOTE: The MD represents the network and voltage measuring instrument and its frequency characteristics per IEC 60601-1.

(1) Connect the ECG/RESP Test Body to the green connector of the device under test.

(2) Configure the safety analyzer as follows (NC):

- Polarity - NORMAL
- Neutral - CLOSED
- GND (Earth) - CLOSED

(3) Power on the device under test.

(4) Read and record the current leakage indicated on the tester.

(5) Configure the safety analyzer as follows (SFC):

- Polarity - NORMAL
- Neutral - OPEN
- GND (Earth) - CLOSED

(6) Read and record the current leakage indicated on the tester.

(7) Configure the safety analyzer as follows (SFC):

- Polarity - NORMAL
- Neutral - CLOSED
- GND (Earth) - OPEN

(8) Read and record the current leakage indicated on the tester.

(9) Configure the safety analyzer as follows (SFC):

- Polarity - REVERSED
- Neutral - CLOSED
- GND (Earth) - OPEN

(10) Read and record the current leakage indicated on the tester.

(11) Configure the safety analyzer as follows (SFC):

- Polarity - REVERSED
- Neutral - OPEN
- GND (Earth) - CLOSED

(12) Read and record the current leakage indicated on the tester.

(13) Configure the safety analyzer as follows (NC):

- Polarity - REVERSED
- Neutral - CLOSED
- GND (Earth) - CLOSED

(14) Read and record the current leakage indicated on the tester.

(15) Power off the device under test.

(16) Repeat the steps in this procedure using the appropriate SPO2 Test Body. Connect the SPO2 Test Body to the blue SPO2 connector of the device under test.

If measured reading is greater than the appropriate specification below, the device under test fails. Contact GE Technical Support.

Acceptance criteria NC

- 10 µA

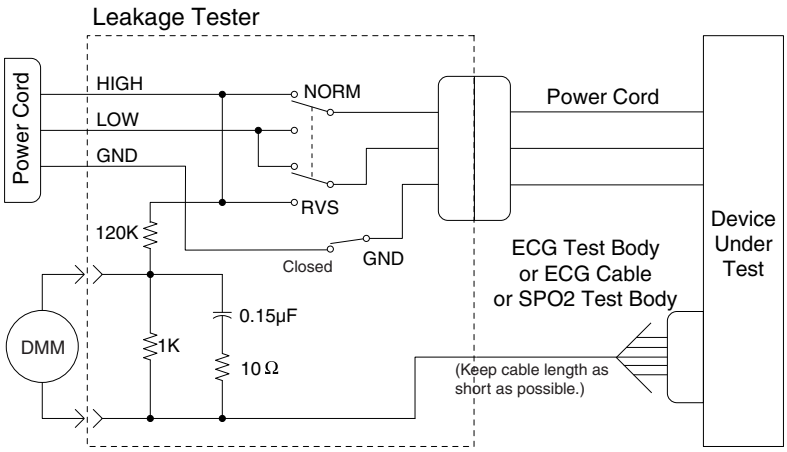
Acceptance criteria SFC - earth open or one of the supply conductors open at a time

- 50 µA

2.10 Patient (sink) leakage current test

This procedure measures the leakage current from a mains voltage source into the ECG/RESP connector or the SpO_2 connector. Perform the test in Normal Condition (NC) with normal and reverse polarity.

NOTE: Refer to the instructions delivered with the safety analyzer to perform this test.



DMM set to measure AC voltage

NOTE: The MD represents the network and voltage measuring instrument and its frequency characteristics per IEC 60601-1.

NOTE: Per IEC 60601-1, the impedance to protect the circuitry and the person performing the test, but low enough to accept currents higher than the allowable values of the LEAKAGE CURRENT to be measured.

WARNING **Shock hazard. The following step causes high voltage at the test body. Do not touch the test body.**

(1) Connect the ECG/RESP Test Body to the green connector of the device under test.

(2) Configure the safety analyzer as follows:

- Polarity - NORMAL
- Neutral - CLOSED
- GND (Earth) - CLOSED

(3) Power on the device under test.

(4) Read and record the current leakage indicated on the tester.

(5) Configure the safety analyzer as follows:

- Polarity - REVERSED
- Neutral - CLOSED
- GND (Earth) - CLOSED

(6) Read and record the current leakage indicated on the tester.

(7) Power off the device under test.

(8) Repeat the steps in this procedure using the appropriate SPO2 Test Body. Connect the SPO2 Test Body to the blue SPO2 connector of the device under test.

If measured reading is greater than the appropriate specification below, the device under test fails. Contact GE Technical Support.

Acceptance criteria

- 50 µA

2.11 Test completion

(1) Disconnect the safety analyzer from the power outlet.
(2) Disconnect the test equipment from the patient monitor.
(3) Disconnect the patient monitor's power cord from the leakage tester.
(4) Fill in all necessary documents.

3 Installation checkout

These instructions include procedures for a installation checkout for B40/B20 monitor. It is recommended to be performed after monitor installation.

Skip the tests that are not applicable for the installed monitor.

These instructions include a "Installation and checkout form, B40/B20" to be filled in when performing the procedures.

An electrical safety check and a leakage current test should be performed prior to the monitor installation.

3.1 Visual inspection

Perform the following visual inspection to the installed monitoring system:

- Carefully inspect the patient monitor if any damage.
- Verify that the patient monitor is properly mounted with specified mounting solutions.
- Verify that the cables between the patient monitor and the connected peripheral devices are intact and properly connected to the right connectors.
- Verify that the modules are properly connected and locked in place.
- Verify that the battery door is properly locked.

The cleaning precautions, cleaning requirements, cleaning procedures, and recommended cleaning solutions for the monitor are described in the "User's Guide". For details about cleaning, disinfecting and sterilizing the accessories, see the instructions for use in the accessory package.

3.2 Functional inspection

3.2.1 Start-up

1. Turn on the patient monitor.

Verify that the monitor starts up normally:

- The red, yellow and cyan alarm lights are lit momentarily.
- The speaker gives an audible beep.
- Check that the GE logo screen is displayed, followed by the notes screen and the normal monitoring screen appears.
- Check and there are no error messages on the screen.

NOTE: Refer to section "Batteries" to see the procedure for battery conditioning if you receive a a ***Condition Battery X*** message.

NOTE: Before taking the patient monitor into use for the first time, the battery should be fully charged. Keep the monitor connected to the mains until the battery is fully charged.

3.2.2 Display

1. Verify that all text is readable and all images are clear.
2. Verify that the brightness is good. Adjust if necessary.

3.2.3 Frame unit

1. Check that the clock on the screen shows correct time. Adjust the time and date, if necessary.

   NOTE: The B40/B20 can't be set as the TIME MASTER in network. You should adjust the time and date from the central station.

3.2.4 Parameters measurements

Connect the accessories (no need connect simulator/patient), check the following phenomenon will appeared.

- ECG: After connecting ECG cable, 'leads off' will display in the Waveform Field
- NIBP: After connecting NIBP hose to module, 'Adult/Pediatric' or 'Neonatal' will display in NIBP Digital Field for several seconds
- SpO_2: After connecting SpO_2 cable and sensor, SpO_2 sensor will be lit.
- Temperature: After connecting Temp cable and sensor, 'Performing temp test:' will display in Temp Digital Field for several seconds.
- IBP: After connecting IBP cable and transducer, 'InvBP's not Zeroed' will display in Message Field.
- CO2: After installing the E-miniC module, 'Calibrating gas sensor' will display in CO2 waveform field for about 1 minutes

3.2.5 Recorder

1. Press the **Recorder Start/Stop** key and check that the module starts recording the selected waveforms. Press the **Recorder Start/Stop** key again to stop recording.
2. Check that the quality of the recordings is acceptable.

3.2.6 Network connection

1. Check that the CAT-5 cable connector is clean and intact, then connect it to the Network connector on the backside of the monitor.

Check that the monitor connects to the network, i.e. the network symbol appears on the upper right-hand corner of the screen.

NOTE: Pre-configure the network when install the monitor.

3.2.7 Conclusion

- Power off the monitor
- Perform final cleaning
- Fill in all necessary documents

4 Maintenance and checkout

These instructions include procedures for maintenance and checkout for the B40/B20. The maintenance should be performed every 12 months.

These instructions include "Maintenance and checkout form, B40/B20", which to be filled in when performing the corresponding procedures.

4.1 Visual inspection/preparation

4.1.1 Before beginning

- Save the patient data and monitor settings if necessary.
- Make sure that the monitor is turned off.
- Disconnect the mains power cord.
- If the monitor is connected to the network, disconnect the CAT-5 cable from the monitor.

4.1.2 General

1. Check that all parts are intact and that the cables and screws are connected and tightened properly. Check the connector pins are intact. Check the front cover and the front panel sticker are intact.
2. Check that the modules go in smoothly and lock up properly.
3. Check the ventilation holes of the monitor and clean if necessary.
4. Check the module and applied parts are clean.

NOTE: Batteries are recommended to be conditioned every six months.

4.2 Functional inspection

4.2.1 General

1. Connect the mains power cord
   Check that the Mains power LED is lit.
2. Switch the monitor on.
   Check that the monitor starts up properly
   - The red, yellow and cyan alarm lights are lit momentarily
   - The loudspeaker gives an audible beep
   - Check that the GE logo screen is displayed, followed by the notes screen and the normal monitoring screen appears.
   - Check and there are no error messages on the screen.
3. Check that the monitor goes to battery use and indicate batteries in use if the main cord is disconnected.

4.2.2 Display

1. Check that the image quality on the screen is correct
2. Check the display brightness

   Select

   Monitor Setup

   Display brightness

   Push the Trim Knob and check that the display brightness follows the selected brightness.

4.2.3 Keyboard(s)

1. Tests with the keyboard/membrane switch:
   - Enter the service menu:
     Monitor Setup - ***Install/Service*** (password 16-4-34) -
     Service (password 26-23-8) - ***Keyboard***
   - Check the keys one by one, turn trim knob one full turn clockwise and one full turn counter clockwise.

4.2.4 Time and date

- Check that the clock on the screen shows correct time.

  Readjust the time and date, if necessary.
  Monitor Setup - ***Time and Date***

  NOTE: The B40/B20 can't be set as the TIME MASTER in network. You should adjust the time and date from the central station.

4.2.5 Hemo Module

ECG measurement

- Configure ECG settings in monitor:
  Connect 5 lead ECG cable to monitor and simulator.
  Monitor Setup -> ***Screen Setup*** -> ***Waveform Fields*** -> ***Field 1***: ECG1; ***Field 2***: ECG2; ***Field 3***: ECG3
  ECG -> ***ECG1 Lead***: II; ***ECG2 Lead***: V1; ***ECG3 Lead***: aVL; ***ECG Size***: 1.0
  ->***ECG Setup*** -> ***Beat Sound Volume***: 1 or greater; ***Pacemaker***: Show; ***HR Source:*** AUTO
- Configure ECG settings in simulator:
  ECG rhythm: a normal sinus rhythm
  heart rate: 80 bpm
  Amplitude: 1 mV

1. Normal Sinus Rhythm

– Check that the monitor displays the ECG leads II, V1 & aVL and the waveforms are noise-free. The monitor shall display a 80 ± 5 bpm heart rate and an audible QRS tone sounds with each QRS complex.

2. Pacemaker Detection
   – Configure the simulator to output "Asynchronous Pacemaker Pulse"
   – Check that pacemaker spikes are shown on the ECG waveform.

3. Asystole Detection
   – Configure the simulator to output "Asystole".
   – Check that the 'Asystole' alarm appears to the monitor screen.
   – Configure the simulator to show "80 beats per minute, Normal Sinus Rhythm".

4. Leads Off Detection
   – Detach the RA/R leadwire from the simulator.
   – Check that the Lead II waveform disappears from the ECG1 waveform field and a message 'RA/R lead off'' is shown momentarily.
   – Check that Lead II is replaced by Lead III in the ECG1 waveform field after a while and a message 'Lead changed' is followed by a message 'Learning'.
   – Reconnect the RA/R leadwire to the simulator.
   – Check that Lead III is replaced back to Lead II in the ECG waveform field.

Respiration measurement

- Configure RESP settings in monitor:
  Set up the Resp waveform field to the monitor screen. And
  Others -> ***RespSetup*** -> ***Resp Rate Source:*** Imped.
  -> ***Measurement***: ON
- Configure RESP settings in simulator:
  Baseline impedance: 1000
  Amplitude: 1
  Respiration rate: 20 breaths per minute
  Lead selection: II (or LL)

5. Respiration Rate
   – Check that the RESP waveform is shown and the RR value is 20 (±5).
   – Configure the simulator's Apnea Simulation to "32 sec".

6. Apnea Detection
   – Check that the monitor activates the Apnea alarm.
   – Configure the simulator's Apnea Simulation to "OFF"

Temperature measurement

- Configure the “T1+T2” digit field to the monitor screen.
- Configure the simulator’s temperature channels as follows:
  Temperature : 37 °C/98.6 °F

7. Temperature detection
   - Check the corresponding temperature value appears and that no error messages are shown on the monitor screen.
     NOTE: If the deviation on a temperature reading on the screen is more than 0.1°C, calibrate the temperature channels according to the instructions in chapter *"Temperature calibration"*.

Invasive blood pressure measurement

- Configure the simulator’s IBP channels as follows:
  Sensitivity: 5 µV/V/mmHg
  InvBP outputs: "0 mmHg static pressure" or "atmosphere"

8. Zeroing
   - Press **IBP Zero All** key.
   - Check that a message "Zeroing" followed by a message "Zeroed" is shown in the IBP parameter window.

9. Static Pressure
   - Configure the simulator's ***InvBP output*** to "200 mmHg static pressure".
   - Check that the flat pressure line appears on the related waveform field. The reading in the parameter window shall be 200 ±10 mmHg.
     NOTE: Recalibration is required, if the measured value is not within the specification. Calibrate the invasive pressure channels according to the instructions in *"Invasive pressure calibration"*.

10. Pressure Waveforms
    - Configure the simulator's ***InvBP output*** to "Arterial 120/80".
    - Check that the pressure waveform for tested invasive pressure channel appears in the IBP waveform field and the Sys/Dia (Mean) pressure values are shown in the related parameter window.

SpO_2 measurement

11. Test measurement

Connect the SpO_2 probe onto your finger. Check that the reading of 90-100 and SpO_2 waveform appears. Check that the HR value is calculated from SpO_2 when ECG and InvBP (ABP or Art) are not measured.

NOTE: a functional tester cannot be used to assess the accuracy of a pulse oximeter probe or a pulse oximeter monitor

Non Invasive Blood Pressure measurement

- Connect and set up the NIBP integrated tool as following picture, ensure all the connections made are leak-proof.

12. NIBP Leak Test
    - Enter the NIBP Calibration in service menu: ***Parameters - NIBP - Calibrations***
    - Select ***Active Leak Test***: ON
    - Wait for 15 seconds for the pressure to stabilize then check that the pressure does not drop more than 6 mmHg per one minute.

13. NIBP calibration
    - Calibrate the Non-invasive blood pressure (NIBP) channel according to the instructions in "NIBP calibrations" on page 3-23.

14. NIBP hose detection
    - Disconnect the calibration test equipment.
    - Attach an infant NIBP cuff hose without cuff identification.
    - Press the **NIBP Start/Cancel** key. The monitor shall automatically open the selections ***NIBP Setup - Inflation Limits*** to user to manually select the inflation limits.

4.2.6 Loudspeaker

Check the loudspeaker by setting the alarm volume:

Alarms Setup

Alarm Volume

Test the whole volume scale from 1 to 10 by turning the Trim Knob and check that the alarm volume changes correspondingly. The alarm sound should be clear and audible with all the settings.

4.2.7 Monitor software

Enter the service menu:

Monitor Setup

Install Service (Password 16-4-34)

Service (Password 26-23-8)

Take down the information regarding Monitor software.

4.2.8 Watchdog circuitry

Select:

Monitor Setup

Install Service (Password 16-4-34)

Service (Password 26-23-8)

Set/Test

Perform the tests ***Watchdog*** and ***WD by Overload***. Check that the monitor restarts in each case.

NOTE: When selecting ***Watchdog*** and ***WD by Overload***, auto restarting should take place approximately after 10 seconds.

4.2.9 Batteries

1. Battery operation

   Disconnect the power cord (without switching the monitor to standby).

   Check that the monitoring continues normally. Check also the keyboard/membrane switch LEDs:

   - the green mains power LED is off
   - the green battery LED is on

- the orange battery LED is off

2. Battery charging

   Reconnect the power cord.

   Check that the monitoring continues without problems. Check also the keyboard/membrane switch LEDs:

   - the green mains power LED is on
   - the green battery LED is off
   - the orange battery LED is on or off continuously (not blinking)

4.2.10 Network

– Connection to network

  Check that the CAT-5 cable connector is clean and intact, then connect it to the monitor.

  Check that the monitor connects to the network, i.e. the network symbol appears in the screen.

4.2.11 Final cleaning

Switch off the monitor and perform final cleaning.
Fill in all necessary documents.

5 Adjustments and calibrations

NOTE: Use only properly maintained, calibrated and traceable measurement equipment for the specified calibrations and adjustments to ensure accuracy.

5.1 NIBP calibrations

NIBP calibration shall be performed:

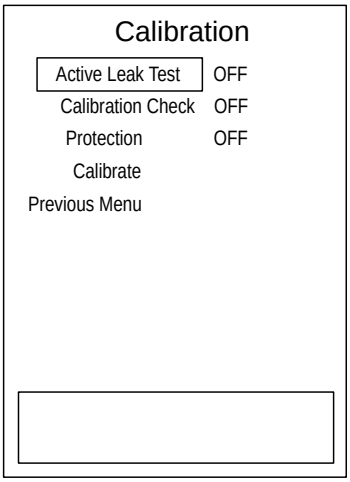
- Each time planned maintenance is performed.
- Each time corrective maintenance is performed.
- If the measured value is not within the specification.

Calibration check

- Refer to the "Non Invasive Blood Pressure measurement" on page 3-20 in maintenance checkout section for NIBP integrated tool set up.

1. Enter ***Calibration*** menu:

   Monitor Setup - *Install/Service* (password 16-4-34) -***Service*** (26-23-8) - ***Parameters - NIBP - Calibrations***



2. Select ***Calibration Check*** and push the Trim Knob.
3. Connect an external precision manometer to the module.
4. Pump the following pressures to manometer and check the difference between the manometer and monitor pressure display (The zeroing offset is automatically subtracted from the pressure readings).

Table 2 NIBP calibration check pressures

Pressure	Max. error	Example
0 mmHg	±5 mmHg (=zero offset)	-1
100 mmHg	100 ±2 mmHg	100 ±2
200 mmHg	200 ±3 mmHg	200 ±3

There is a reading of B1 and B2 in help filed under NIBP calibration menu. If the error of pressure channel B1 and B2 is larger than specified above, the module should be recalibrated. The error of B2 has no effect on blood pressure measurement accuracy.

NOTE: If the monitor pass the calibration check, no need to do NIBP calibration.

Calibration

1. Enter ***Calibration*** menu.
2. Disconnect the hoses from the NIBP connector to enable proper zeroing.
3. Select ***Calibrate***. If it is not available, perform the steps a and b.

a. Select ***Protection OFF*** in the ***Calibration*** menu and push the Trim Knob.

b. Menu selection ***Calibrate*** is now enabled.

- Start calibration by pushing the Trim Knob. Messages 'Zeroing' and 'Zeroed' will be displayed in the NIBP message field.
- Connect an external mercury manometer with a pump to the module through the both tubes of the hose - both transducers B1 and B2 will be calibrated simultaneously. Pump up to a pressure of about 200 mmHg according to the manometer. Calibration is possible in the range of 150 to 250 mmHg.
- Verify that both pressure values in the prompt field match the manometer reading. If not, adjust by turning the Trim Knob. When the values of the pressure bar and the manometer are equal, push the Trim Knob to confirm the calibration. The message 'Calibrating' and 'Calibrated' will be displayed on the NIBP digit field after a few seconds.
- To set the protection on:
  Select ***Protection ON*** and push the Trim Knob.
  NOTE: If a long time not choose ***ON*** manually, this menu will automatically return to ***Protection ON.***

5.2 Temperature calibration

Temperature calibration shall be performed:

- If the temperature test values differ for more than 0.1 °C.
- After STP/TP board replacement.

1. Connect the TEMP accessories to the monitor, use P/N 884515-HEL Temperature calibration plugs
2. Enter STP Module service menu.
   Monitor Setup - ***Install/Service*** (password 16-4-34) - ***Service*** (password 26-23-8) - ***Parameters*** - ***STP***.
3. Enter ***Calibrations*** menu.
4. Choose ***Protection OFF*** in protect mode.
5. Select ***Calibrate T1/Calibrate T2***.
6. Insert calibration plug (25 °C) into T1/T2 connector.
7. Push the Trim Knob.
8. Insert calibration plug (45 °C) into T1/T2 connector.
9. Push the Trim Knob.

- Check ***Protection ON*** in protect mode.
  NOTE: If a long time not choose ***ON*** manually, this menu will automatically return to ***Protection ON.***

5.3 Invasive pressure calibration

IBP calibration shall be performed:

- When the pressure transducer (probe) is replaced with a different type of transducer.
- When the measured value is not in the acceptable specification.
- After STP board replacement.

NOTE: Before starting invasive pressure calibration, disconnect all patient cables and discharge the patient.

It's two methods to do the calibration as following:

Using transducer

1. Connect the IBP accessories to the monitor, use a pressure manometer with a pressure pump
2. Enter STP service menu.

   Monitor Setup - ***Install/Service*** (password 16-4-34) - ***Service*** (password 26-23-8) - ***Parameters*** - ***STP***.
3. Enter ***Calibrations*** menu.
4. Choose ***Protection OFF*** in protect mode.
5. Connect a pressure transducer with a pressure manometer to the P1/P2 connector. Choose ***Calibrate P1*** or ***Calibrate P2***. Leave the transducer to room air pressure.
6. Push the Trim Knob to start zeroing.
7. Supply a pressure of 100 mmHg to 300 mmHg to the transducer. The recommended pressure is 200 mmHg.
8. Set the pressure on the display to match the pressure reading on the manometer and push the Trim Knob. A tolerance of ±1 mmHg is allowed.
9. The message 'Calibrated' will be displayed on the display.

- Check ***Protection ON*** in protect mode.
  NOTE: If a long time not choose ***ON*** manually, this menu will automatically return to ***Protection ON*.**

Using simulator

1. Connect the IBP accessories to the monitor and simulator.
2. Enter STP service menu.

   Monitor Setup - ***Install/Service*** (password 16-4-34) - ***Service*** (password 26-23-8) - ***Parameters*** - ***STP***.
3. Enter ***Calibrations*** menu.
4. Choose ***Protection OFF*** in protect mode.
5. Choose ***Calibrate P1*** or ***Calibrate P2***. Set the P1 or P2 channel to 0 mmHg on the simulator.
6. Push the Trim Knob to start zeroing.
7. Set a pressure of 100 mmHg to 300 mmHg on the simulator. The recommended pressure is 200 mmHg.
8. Set the pressure on the display to match the pressure reading on the simulator and push the Trim Knob. A tolerance of ±1 mmHg is allowed.
9. The message 'Calibrated' will be displayed on the display.
10. Check ***Protection ON*** in protect mode.

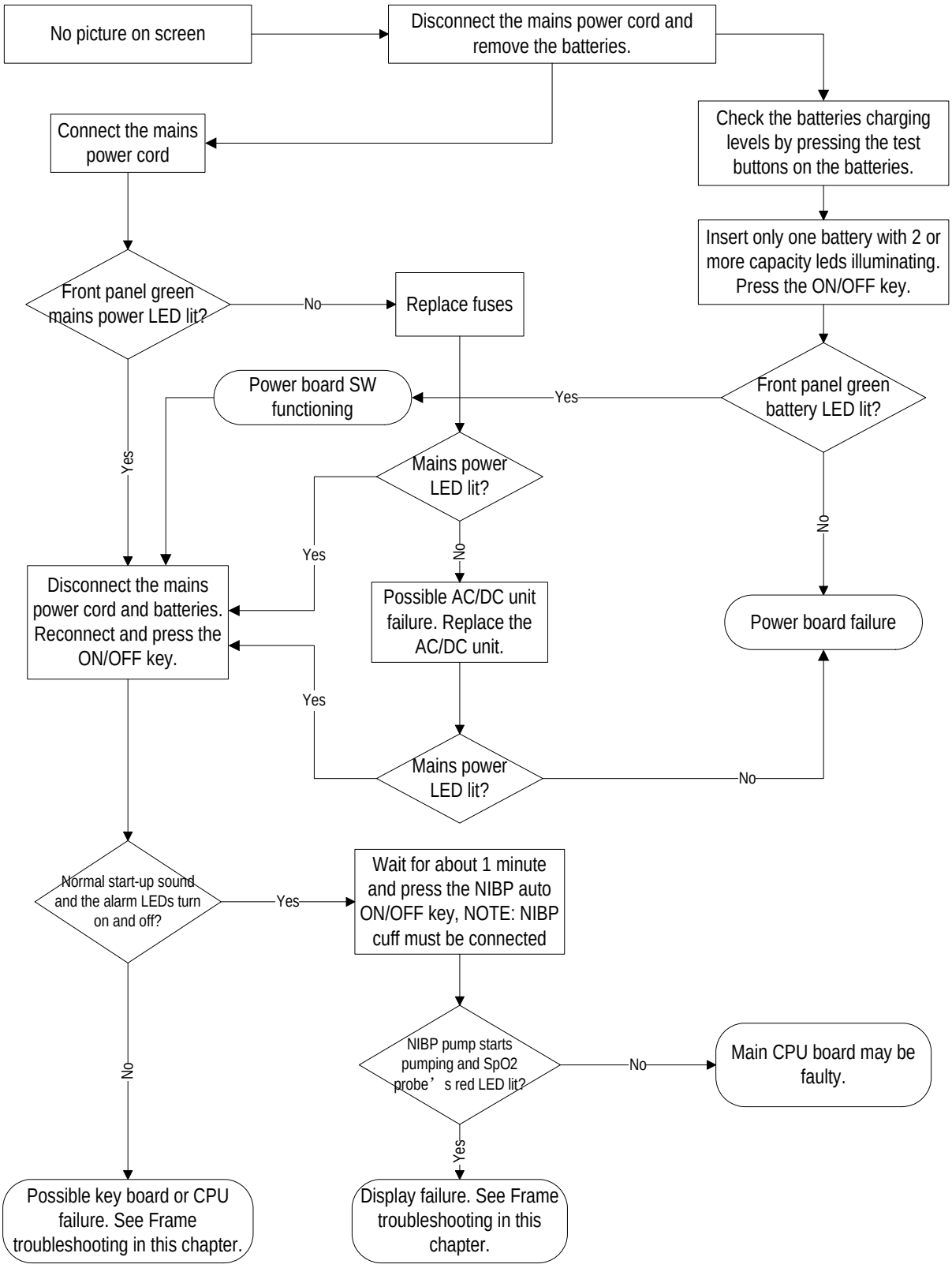
4 Troubleshooting

1 Introduction

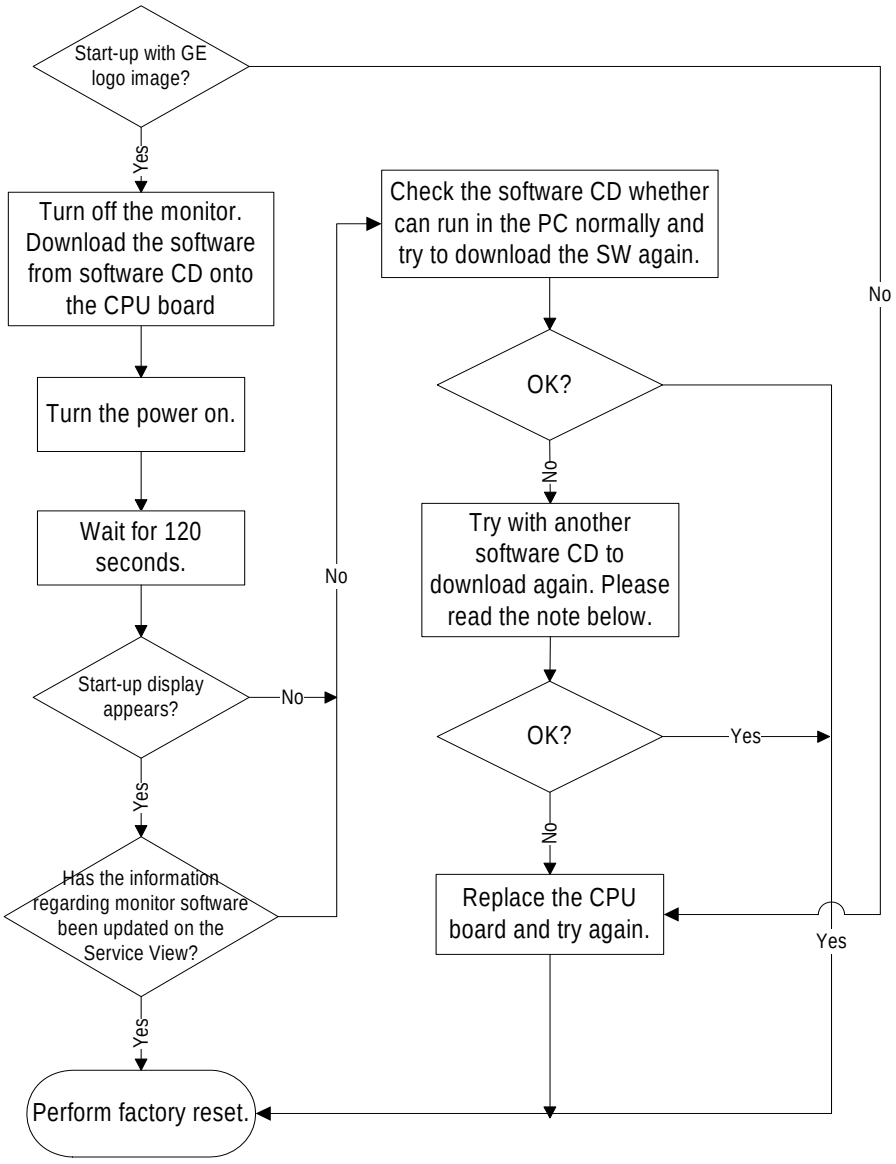
If a problem occurs during the functional examination, check the components of the monitor according to the below troubleshooting table. If the problem persists, please refer to the following detail troubleshootings.

Problem	What to do
Nothing functions	Unplug and re-plug the Power Cord. Also confirm that the cable is intact. Confirm that the fuses are intact.
Hemo module does not function	Remove and replace the Hemo module. Confirm that the desired parameters are configured to be displayed.
E-miniC module does not function	Confirm that 'Calibrating Gas Sensor' messages are not displayed. Confirm that a D-fend water trap and a sample tube are attached. Confirm that the desired parameters are configured to be displayed. Remove and replace the module.
Network does not function	Refer to 1.5. Connection to Network section in Installation chapter about network's configuration.

1.1 General troubleshooting


No picture on screen
Disconnect the mains power cord and remove the batteries.
Connect the mains power cord
Check the batteries charging levels by pressing the test buttons on the batteries.
Insert only one battery with 2 or more capacity leds illuminating. Press the ON/OFF key.
Front panel green mains power LED lit?
No
Replace fuses
Power board SW functioning
Yes
Front panel green battery LED lit?
Yes
Mains power LED lit?
Yes
No
No
Disconnect the mains power cord and batteries. Reconnect and press the ON/OFF key.
Possible AC/DC unit failure. Replace the AC/DC unit.
Power board failure
Yes
Mains power LED lit?
No
Normal start-up sound and the alarm LEDs turn on and off?
Yes
Wait for about 1 minute and press the NIBP auto ON/OFF key, NOTE: NIBP cuff must be connected
NIBP pump starts pumping and SpO2 probe's red LED lit?
No
Main CPU board may be faulty.
No
Yes
Possible key board or CPU failure. See Frame troubleshooting in this chapter.
Display failure. See Frame troubleshooting in this chapter.

1.2 Software troubleshooting chart


Start-up with GE logo image?
Yes
No
Turn off the monitor. Download the software from software CD onto the CPU board
Turn the power on.
Wait for 120 seconds.
Start-up display appears?
No
Yes
Has the information regarding monitor software been updated on the Service View?
No
Yes
Perform factory reset.
Check the software CD whether can run in the PC normally and try to download the SW again.
OK?
No
Yes
Try with another software CD to download again. Please read the note below.
OK?
Yes
No
Replace the CPU board and try again.
Yes

NOTE:
The software CD may be defective.

2 Frame troubleshooting

Problem	Cause	What to do
Monitor is not starting.	1. The batteries are empty. 2. Fuses may be blown. 3. If power cord connected, AC/DC unit may be faulty. 4. If AC/DC unit is working, the power board may be faulty. 5. On/Stby key may be faulty.	1. Connect the power cord. 2. Replace fuses. 3. Replace the AC/DC power unit. 4. Replace the power board unit. 5. Replace the keyboard/membrane switch panel or the interconnection cable.
Monitor is not starting.	1. The connection between power board and CPU board may be faulty. 2. Faulty CPU board.	1. Check connection between power board and CPU board. 2. Replace the CPU board.
The monitor starts (alarm beep is heard), but the display remains black.	1. The LCD display cables are loose. 2. The backlights are not lit.	1. Check the LCD display connection board connectors. 2. Check inverter cable. Backlight Inverter may be faulty. Replace the Inverter board.
Display and monitor operating but no audible beep in start-up.	1. Loudspeaker connector or wires loose or faulty.	1. Check loudspeaker connector and wires.
Display is too dim.	1. Incorrect brightness adjustment. 2. Backlight faulty. 3. Backlight inverter faulty.	1. Adjust display brightness higher. 2. Check inverter cable. 3. Replace backlight.
Stripes or white areas on screen.	1. Loose faulty display connection cable in CPU and display.	1. Check display connection cable in CPU and display.
Module data disappears from the screen. 'Module power supply overload' message.	Parameter module current (in module bus) too high.	Detach and change parameter module.
Module data disappears.	1. Module bus voltage or signals path broken.	1. Replace module interface board. 2. Replace the cable between module interface board and Power board. 3. Change the parameter module.
'Replace Battery' message on the screen.	1. Problem in communication between battery and power board. 2. Battery too old or defected. 3. power board may be faulty. 4. Problem in communication between power board and CPU	1. Replace battery. 2. Replace battery. 3. Replace the power board.
'Frame temperature high' message.	The temperature inside the frame is too high.	Check monitor ventilation holes.
'Battery temperature high' message on the screen.	Battery SMBus temperature is too high.	Check monitor ventilation holes. Replace battery.

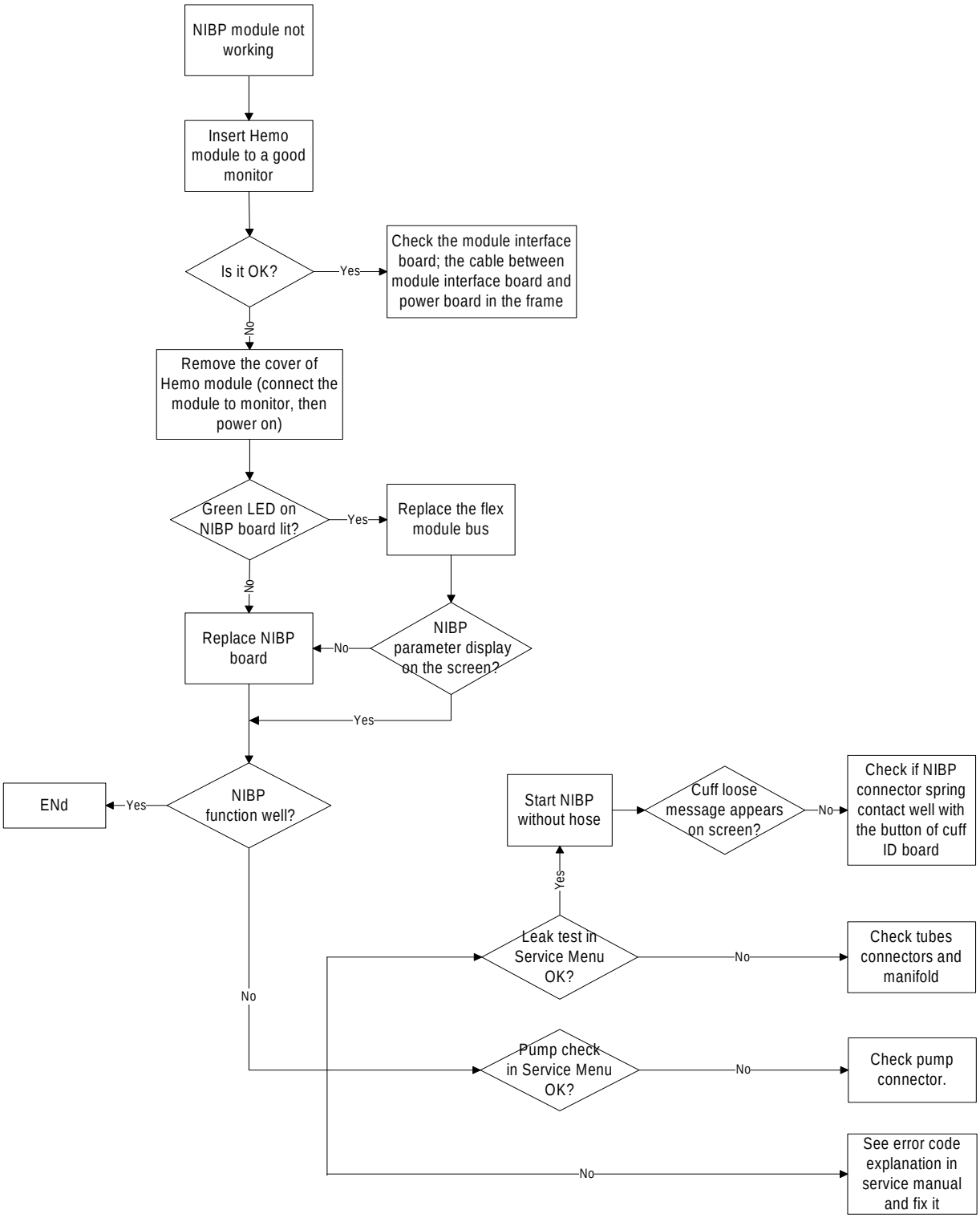
Problem	Cause	What to do
Keyboard not working, but module communication is OK.	Keyboard cables and connectors may be faulty.	1. Check the keyboard/membrane switch connection to the user interface board. 2. Check the interconnection cable between user interface board and battery board.
Keyboard not working, and module communication not working.	UPI section of the CPU board not functioning normally.	Restart the monitor. Replace the CPU Board.
Keyboard partly not working.	1. Keyboard/membrane switch faulty. 2. Keyboard cables and connectors may be faulty.	1. Check the interconnection cable between user interface board and battery board. 2. Check the keyboard/membrane switch connection to the user interface board. 3. Replace the keyboard/membrane switch.

2.1 NET section troubleshooting

Problem	Cause	What to do
Monitor does not connect to the network. Monitor connects to the network, but disconnects unexpectedly ('Network down: central serve' message on the monitor screen).	Patch panel	Patch cable not connected to HUB or to panel.
	Patch cable	Patch cable or connector defective.
		HUB not connected to power supply.
		HUB port closed due to physical layer problems.
		HUB port temporarily closed and reopened due to physical layer problems.
		HUBs not properly connected to each other.
	Monitor-Network cable	Cable not properly connected to the wallplate or to the monitor.
		Cable or connector defective.
	Network cable (inside the monitor) defective	Replace the Network cable - in FRU 2053489-004.
	External interface board defective	Replace the External interface board - in FRU 2053489-004.
	Net section of the CPU board	The NET section is defective. Replace the CPU board.
	NET section memory on the CPU board	The SDRAM of the NET section is defective or uninitialized. The NET cannot be used. See network service page for details.
'Check network connectors' message shows on the monitor screen	Monitor-Network cable	Cable not properly connected to the wallplate or to the monitor. Cable or connector defective.
	Network cable (inside the monitor) defective	Replace the Network cable - in FRU 2053489-004.
	External interface board defective	Replace the External interface board - in FRU 2053489-004.
	Didn't properly set up "virtual plug id"	Set up the virtual plug id in monitor.
Network printing fails	Print server is busy	Network manager's print server is busy at the moment and cannot take more print jobs. Try again after 15 seconds.
	Print queue is full	There are too many unprinted documents waiting in the print queue. Check the printer, as it is not operating properly.
	Printer is off-line	Printer cable is loose, printer is out of paper, there is a paper jam or the printer is simply switched to off-line state.

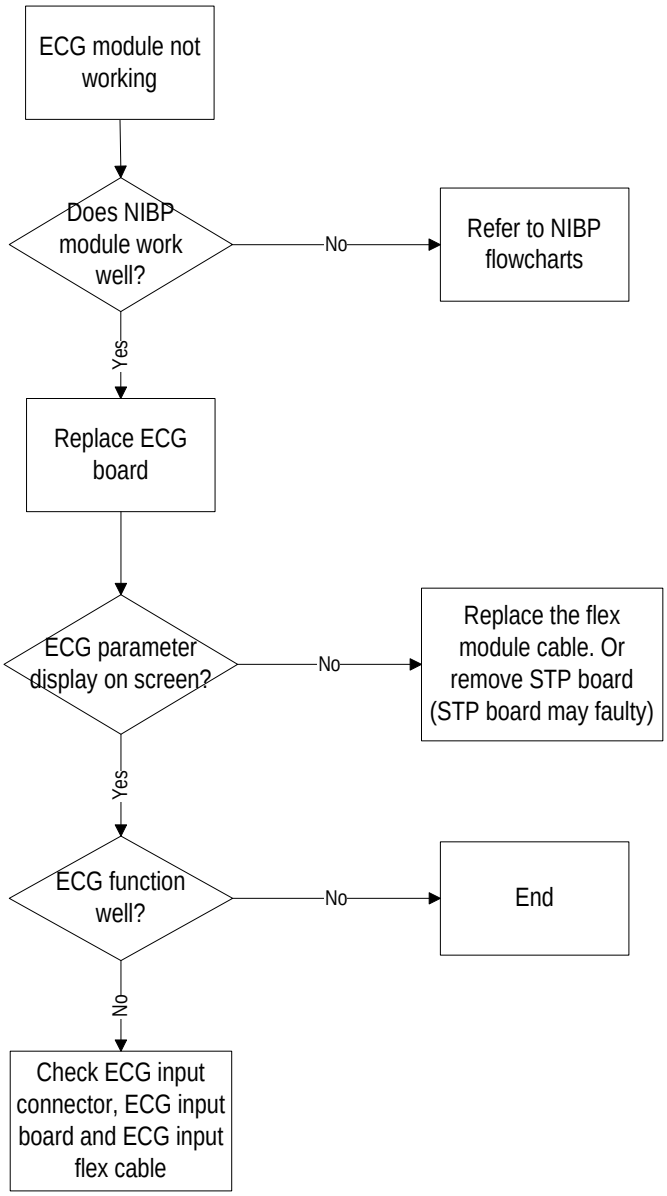
3 Hemo Troubleshooting

3.1 NIBP troubleshooting flowchart

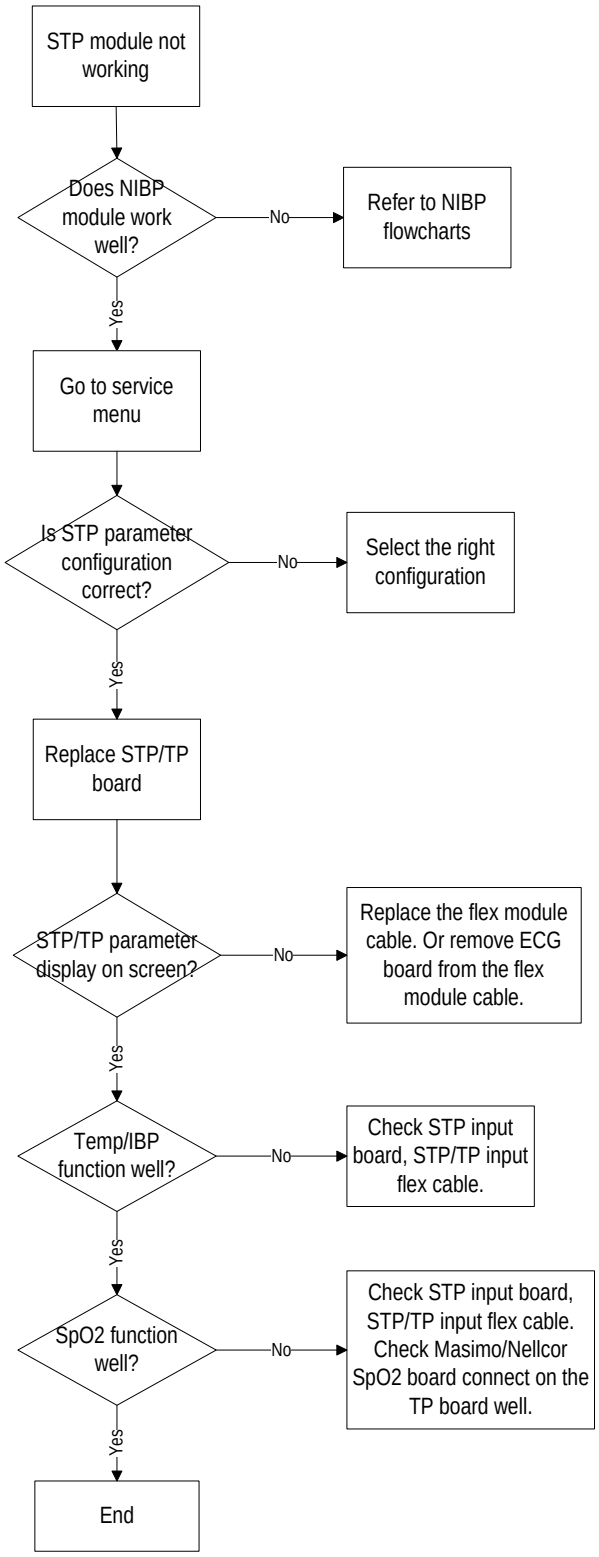

NIBP module not working
Insert Hemo module to a good monitor
Is it OK?
Yes
Check the module interface board; the cable between module interface board and power board in the frame
No
Remove the cover of Hemo module (connect the module to monitor, then power on)
Green LED on NIBP board lit?
Yes
Replace the flex module bus
No
Replace NIBP board
No
NIBP parameter display on the screen?
Yes
ENd
Yes
NIBP function well?
Start NIBP without hose
Cuff loose message appears on screen?
No
Check if NIBP connector spring contact well with the button of cuff ID board
Yes
Leak test in Service Menu OK?
No
Check tubes connectors and manifold
No
Pump check in Service Menu OK?
No
Check pump connector.
No
See error code explanation in service manual and fix it

NOTE: Please refer to 4.4. NIBP Module in Chapter 5 for Service Menu instruction.

3.2 ECG troubleshooting flowchart



3.3 STP troubleshooting flowchart



3.4 NIBP

3.4.1 NIBP toubleshooting

Problem	Cause	What to do
No NIBP value displayed	NIBP not selected on screen.	Check monitor setup.
'Weak pulsation' message	Weak or unstable oscillation pulses due to: • artifacts • weak pulse pressure due to arrhythmias • improper cuff position or attachment • too few pulses detected • weak or unusual blood circulation • obese patient	Check patient condition and retry. Check any leaks and retry. Use proper size of cuff. Check attachment.
Call service 'Error X' message	NIBP hardware error. X = error number.	See the description of the error message code.
'Cuff loose' message	1. Hose and/or cuff not connected.	1. Connect the hose and the cuff.
	2. Hose and cuff connected. Reasons:	
	- cuff loosely wrapped	- Tighten the cuff.
	- leakage inside the shield, in the Patient connector panel or tubings connecting to the module	- Check the tubings inside the shield and Patient connector panel, fix if necessary.
	- leakage in cuff or hose	- Replace cuff/hose.
	- leakage inside module	- Check internal tubing and fix if necessary.
	- pump does not work	- Check pump connector; if OK, replace the NIBP Pump Unit.

Problem	**Cause**	**What to do**
Air leakage	1. Hose or cuff leaking. Reasons:	1. Replace cuff
	- cuff damaged	- Replace cuff.
	- cuff connector damaged	- Replace cuff connector (if the fault is in hose connector).
	- O-ring damaged or missing	- Replace O-ring.
	- hose double connector damaged	- Replace NIBP cuff hose.
	2. Hose and cuff OK. Reasons:	2. Connect or replace tube
	- leakage in the tubes connecting the patient connector panel and the module	- Check the tubes.
	- leakage inside the module	- Replace the whole tubing.
	- tube disconnected or damaged	- Fix connections.
	- manifold leaking	- Replace the manifold.
	- tubes or valve(s) damaged	- Replace tubes/valve(s).
'Cuff occlusion' message	1. Cuff and/or hose occluded. Reason:	
	- cuff tube kinked	- Straighten tube.
	- tubes inside the shield kinked	- Straighten tubes.
	- tubes inside module kinked	- Straighten tubes.
	- occlusion inside/outside module	- Remove occlusion.
	2. Cuff, hose, and tubes OK. Reason:	
	- fault in pressure transducer	- Replace the NIBP board.
	- fault in A/D converter	- Replace the NIBP board.
	- faulty calibration	- Check calibration.

3.4.2 NIBP error code explanation

Code	Problem	What to do
0	RAM test failure	Change the NIBP board.
1	ROM checksum failure	Change the NIBP board.
2	Pump on during idle or over current detected	Check short circuits. Change the NIBP board.
3	Startup communication failure with safety CPU	Change the NIBP board.
4	EEPROM protection is off	Protect calibration by selecting Protection ON in the NIBP calibration menu.
5	EEPROM read/write error	Change the NIBP board.
6	Valve stuck closed during cuff typing	Try to remeasure. If the problem persists, recalibrate. If the problem still persists, change the NIPB board.
7	Could not save calibration data	Reset the module and recalibrate. If this does not help, change the NIBP board.
8	PT2 higher than 150 for greater than 15 seconds while idle	Check short circuits. Change the NIBP board.
9	Determination time too long	Automatic recovery.
10	RTK 400Hz timer re-entry	Change the NIBP board.
11	RTK 50Hz timer re-entry	Change the NIBP board.
12	Not in use	Not in use.
13	RTK overrun	Change the NIBP board.
14	Too early AUTO START according to module check	Reset the monitor.
15	Calibration data invalid on initialization or unit never calibrated	Recalibrate. If this does not help, change the NIBP board.
16	Communication timeout between main and safety CPU	Check short circuits. Change the NIBP board.
17	Safety CPU report communication timeout	Check short circuits. Change the NIBP board.
18	Wrong message rate in communication between main and safety CPU >< $\pm$2% (480 msg/s)	Check short circuits. Change the NIBP board.

3.5 ECG

Problem	**Cause**	**What to do**
HR numerical display shows '---'	No heart rate available.	If no ECG waveform, check LEADS OFF message and connect the leads.
		If ECG waveform exists, check heart rate source e.g. in the ECG Setup menu behind ECG key.
Unacceptable ECG waveform	Poor electrode or poor electrode skin contact.	Electrodes from different manufacturers are used. /Too much/little gel is used.
	Poor electrode condition.	Electrodes are dried out.
	Improper site of electrodes.	Check that electrodes are not placed over bones, active muscles, or layers of fat.
	Improper skin preparation.	Remove body hair. Clean attachment site carefully with alcohol.
	Improper bandwidth filter.	Check filter.
	Dirty ECG cable.	Clean the cable.
	Faulty ECG cable	Change the cable.
No ECG trace	Waveform not selected on screen.	Press the **Monitor Setup** key and make adjustments.
	Module not plugged in correctly.	Check the hemo module's installation.
Noise-message	High frequency or 50/60 Hz noise.	Isolate noise source.

3.6 Impedance respiration

Problem	Cause	What to do
No resp trace	Waveform not selected on the screen	Press the **Monitor Setup** key and make adjustments.
	Module not plugged in correctly	Check the hemo module's installation.
Unacceptable resp waveform	Poor electrode or poor electrode skin contact	Electrodes from different manufacturers are used. Too much/little gel is used.
	Poor electrode condition	Electrodes are dried out.
	Improper site of electrodes	Check that electrodes are not placed over bones, active muscles, or layers of fat.
	Improper skin preparation	Remove body hair. Clean attachment site carefully with alcohol.
	Faulty/ dirty ECG cable.	Change new cable.
APNEA message, and respiration waveform normal	Respiration source is CO_2	Check respiration source and change it to correct one.

3.7 Pulse oximetry (SpO_2)

Problem	Cause	What to do
Message 'NO PROBE'	No sensor connected to the module SpO2 connector.	Check sensor connections.
	Sensor faulty.	Change the sensor.
	The type of sensor incorrect.	Change the sensor.
	Flat cable connecting the SpO2 connector to the STP board loosen or broken.	Check the Flat cable, replace if necessary.
Message 'PROBE OFF' though sensor properly attached to the patient	Unsuitable site.	Try another site.
	Sensor faulty.	Try another sensor.
	Sensor connection cable not connected to sensor.	Connect the cable to sensor.
Finger sensor falls off	Sensor is slippery.	Wipe with 70% isopropyl alcohol and allow drying.
	Finger is too thin or thick.	Try other fingers, or other sensor types.
Weak signal artifacts	Poor perfusion.	Try another place.
	Movement artifacts.	
	Shivering.	
Message 'CHECK PROBE'	Singal quality is too low to perform SpO2 measurements.	Check probe condition or try another sensor.
	The type of sensor incorrect.	Change the sensor.
	The monitor's configuration for SpO2 is not correct.	Check the monitor's configuration.
Message 'FAULTY PROBE'	Sensor is faulty.	Change the sensor.
	The type of sensor incorrect.	Change the sensor.
	The monitor's configuration for SpO2 is not correct.	Check the monitor's configuration.
No SpO_2	No waveform selected on screen.	Check the selected SpO_2 waveforms by pressing **Monitor Setup** key and selecting ***Screen Setup - Waveform Fields***.
	Wrong configuration setting.	Check the configuration settings from the STP/Calibrations menu (**Monitor Setup - *Install/Service - Service - Parameters***)

3.8 Temperature

Problem	Cause	What to do
No temperature displayed	Wrong type of probe.	Use correct probe.
	Temperature out of measurable range.	The range is between 10 and 45 °C.
	Temperature calibration not protected.	Set the protection ON in the Service Menu.
	The monitor not configure TEMP.	Check the monitor's configuration.

3.9 Invasive blood pressure

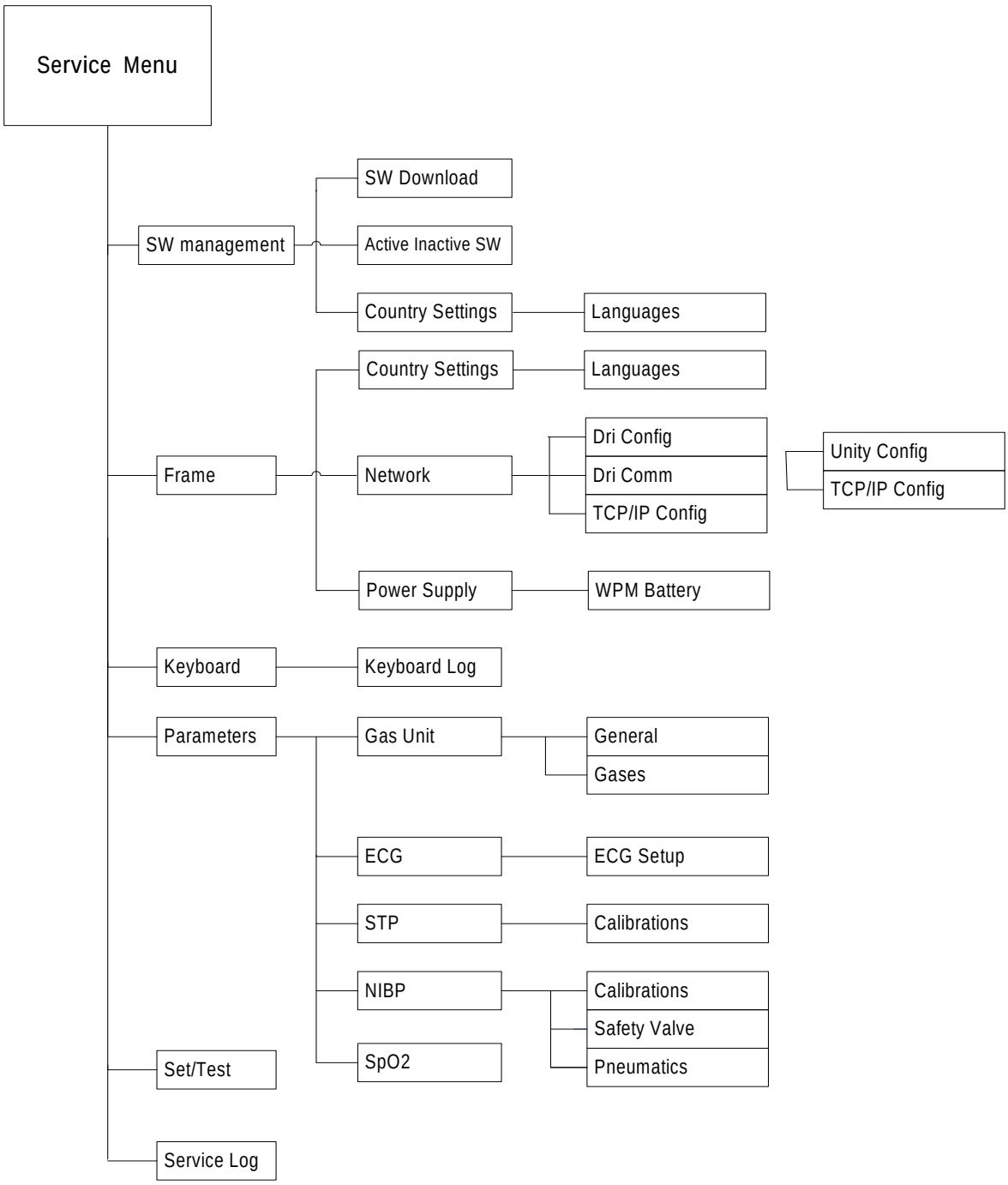
Problem	Cause	What to do
Abnormally low pressure	Transducer wrongly positioned.	Check mid-heart level and reposition transducer.
No pressure 'Not zeroed' message	Defective transducer.	Check transducer.
	No pressure module plugged in.	Check the module.
	No waveform selected on screen.	Check the selected pressure waveforms by pressing **Monitor Setup** key and selecting ***Screen Setup - Waveform Fields***.
		Check that the pressure transducer is open to the patient.
	Wrong configuration setting	Check the configuration setting from the STP/Calibrations menu (**Monitor Setup** - ***Install/Service - Service - Parameters***).
	Measurement on, channel not zeroed.	Zero the channel.
Invasive pressure calibration is not selectable	Patient case is active	Discharge a patient and make sure that the hemo module does not receive any signals from a simulator.
Out of range < - 40 mmHg	Measurement pressure is beyond the measurement range.	Check the transducer level. Zero the channel.
Out of range > 320 mmHg	Measurement pressure is beyond the measurement range.	Check the transducer level. Zero the channel. The patient may also have high pressure.
Out of range	Measured pressure is beyond the internal measurement range of the module.	The waveform hits the top and the numeric display not shown. Check the transducer and its level. Zero the channel.

5 Service Menu

1 Introduction

The monitor has a **Service Menu**, which is a useful tool to examine monitor functions and troubleshoot in case a fault occurs.

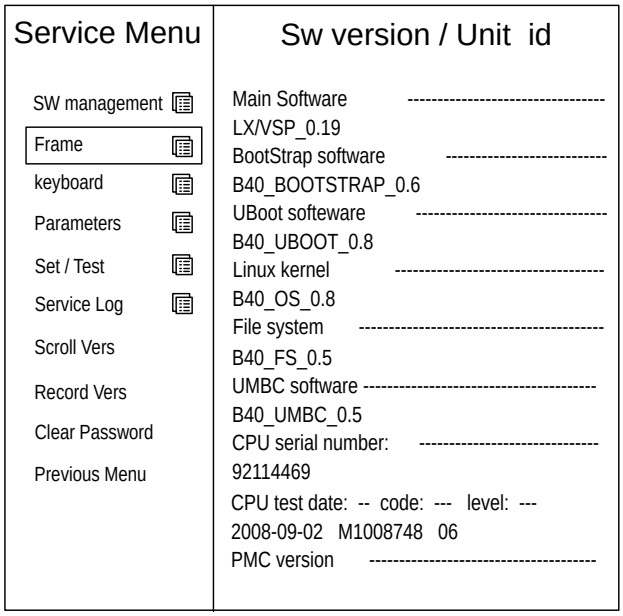
1.1 Service Menu structure



1.2 Service Menu

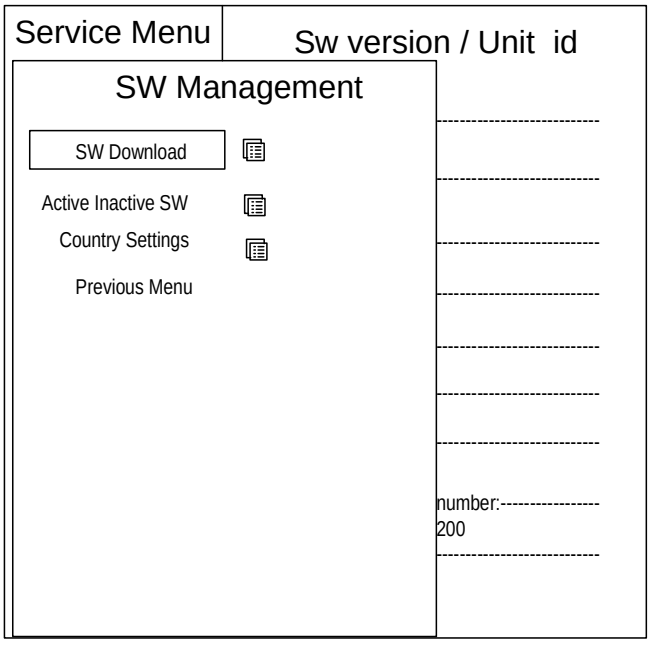
NOTE: The Service Menu pictures are for reference only. Details on the menu page can vary depending on the software version and the module type in use. If a particular selection is not available in your system, the selection is shown grayed.

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** (password 16-4-34).
3. Select ***Service*** (password 26-23-8).



2 SW Management

The SW Management menu includes Software-specific service menus.

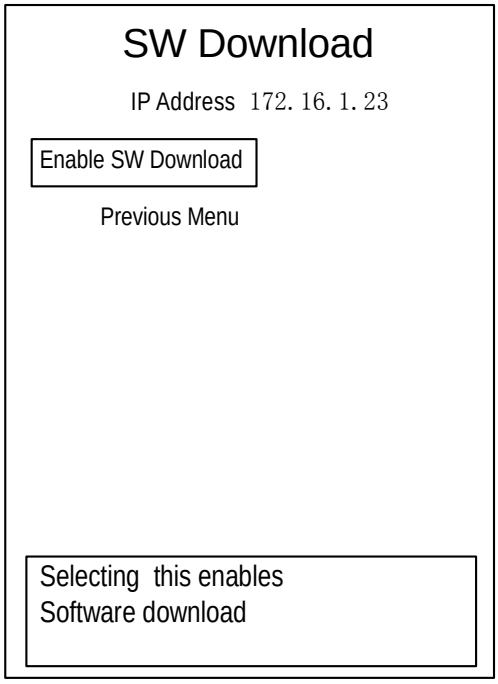


2.1 SW Download

The SW Download submenu show IP Address and enable software download.

IP Address: Show the IP Address of the monitor.

Enable SW Download: Select ***YES*** can enable to download main software.

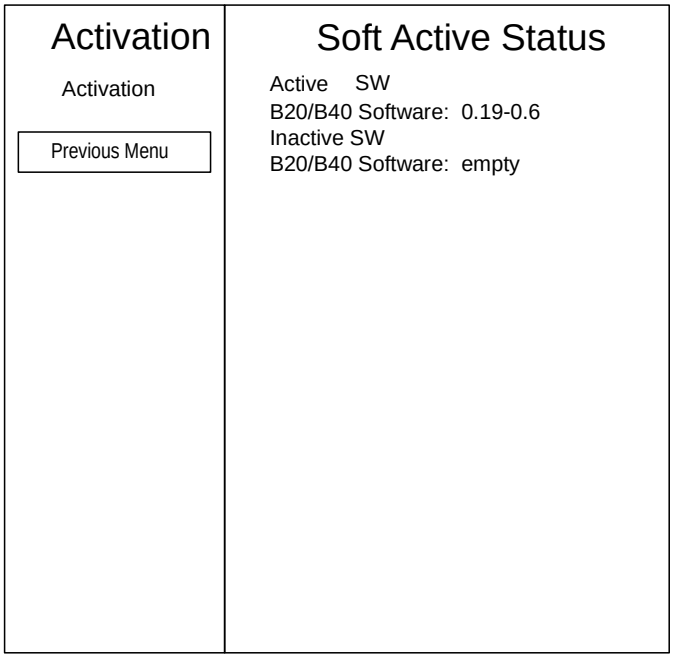


2.2 Active Inactive SW

The Active Inactive SW submenu allows you to active inactive software.

Activation: Selection of activation can restart the monitor and change the main software from active software to incative software.

NOTE: If there is no inactive software in the monitor, the selection is grayed.

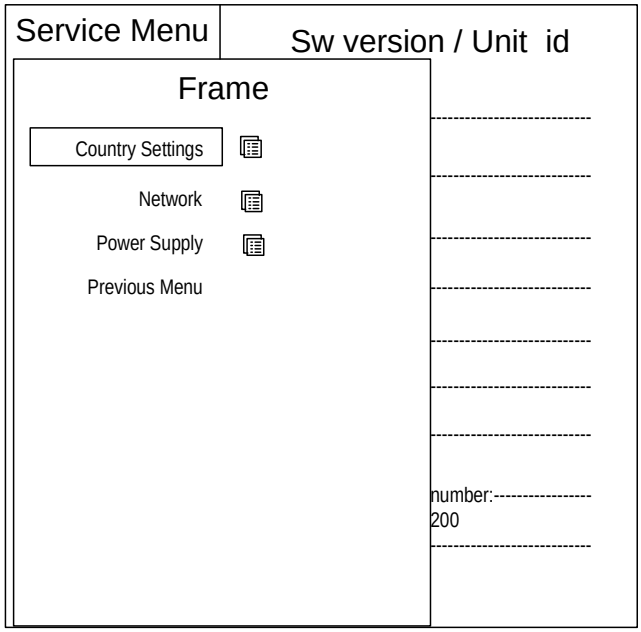


2.3 Country Settings

The Country Settings submenu can be refered to 3.1. Country Settings.

3 Frame

The Frame menu includes frame-specific service menus.



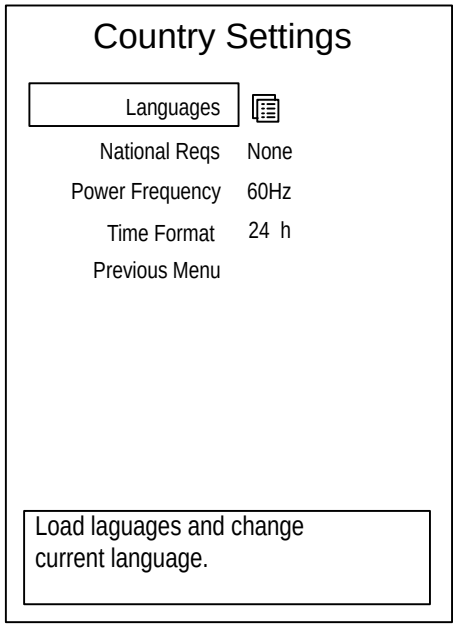
3.1 Country Settings

The language submenu allows you to select and delete language files.

National Reqs: Select software features that include national requirements.

Power Frequency: Set the power frequency (50/60 Hz). This setting is used to filter out possible power frequency interference from parameter measurements.

Time Format: Set the time format of the real-time clock (12 h or 24 h).



Languages

Language

Select a language to be used during monitoring.

NOTE: Service pages will always appear in English despite of this selection.

NOTE: For language codes, see the table below.

Delete Language

Delete a language file from the permanent memory of the monitor.

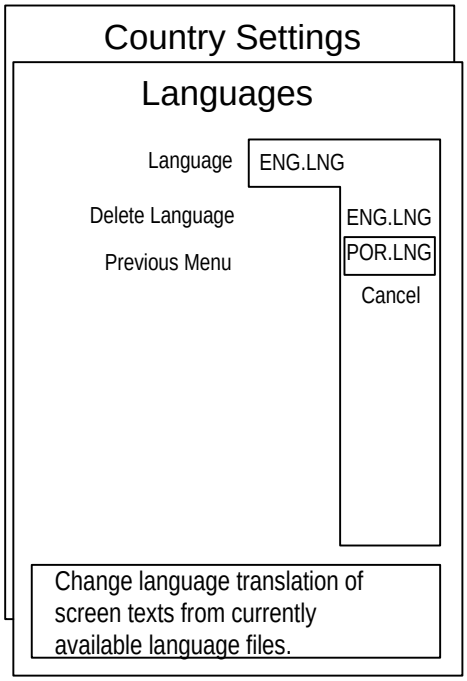


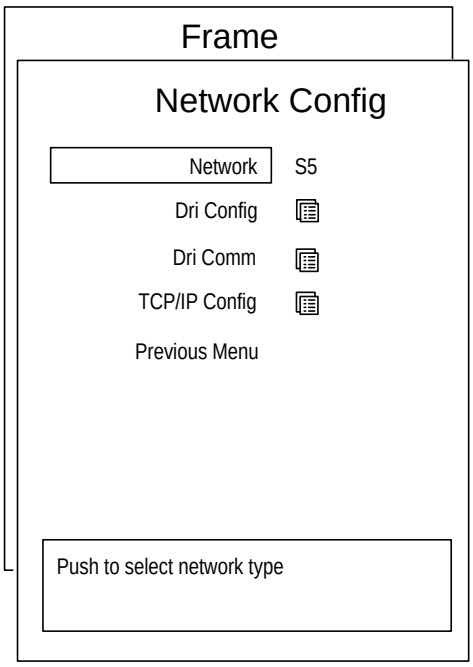
Table 4 Language abbreviations in language file names

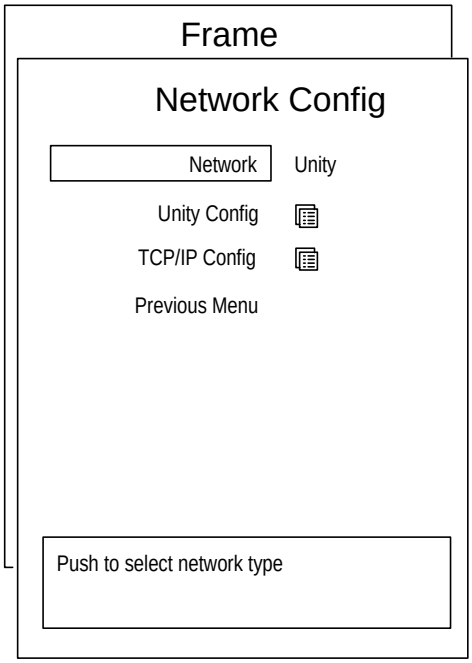
Abbreviation	Language
CHI	Chinese
CZE	Czech
DAN	Danish
ENG	English
FRE	French
GER	German
HUN	Hungarian
ITA	Italian
NLB	Dutch
NOR	Norwegian
POL	Polish
POR	Portuguese
RUS	Russian
SPA	Spanish
SWE	Swedish
TUR	Turkish

3.2 Network

3.2.1 Network

For setting the monitor's network mode: S5/Unity





3.2.2 Dri Config (in S/5)

The DRI Level: For setting the monitor's network communication. The network communication needs match to the iCentral's configuration

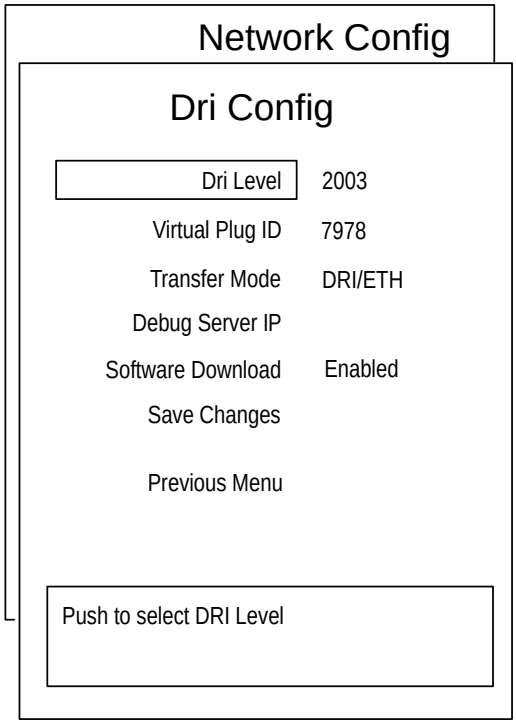
Virtual Plug ID: For setting the same plug ID as in iCentral's.

Transfer Mode: For choosing the transfer mode: DRI/ETH or DRI/UDP

Debug server IP: For R&D purpose only.

Software download: For setting software download capability.

Save Changes: Select "Save Changes" to take in use changes made in this page.



3.2.3 Dri Comm (in S/5)

Session layer

Dest. name shows the name of the Central the monitor is connected to.

Dest. id shows the Central Subnet.

Dest. address shows the MAC address of the monitor network NIC in Central.

Protocol specific situations:
For R&D purpose only.

Tx resent critical

Rx non-critical duplicate

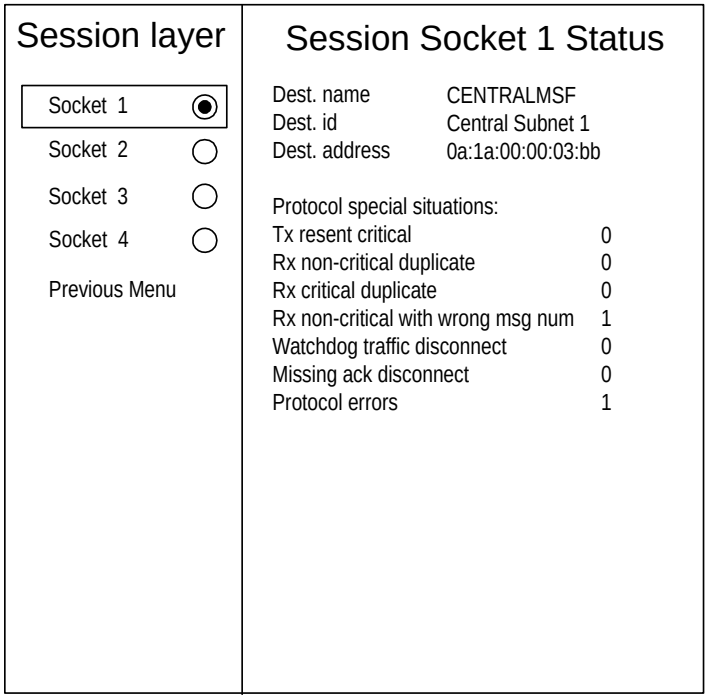
Rx critical duplicate

Rx non-critical with wrong msg num

Watchdog traffic disconnect

Missing ack disconnect

Protocol errors.



Ethernet

The **Ethernet Status** view shows the general status of the ethernet network communication.

Driver: Ethernet chip name.

Cable: Indicates if the ethernet cable is connected.

EthernetAddr: Monitor's ethernet address.

Speed: Indicates the current ethernet communication speed.

The service data related to the ethernet status view is described in the following table.

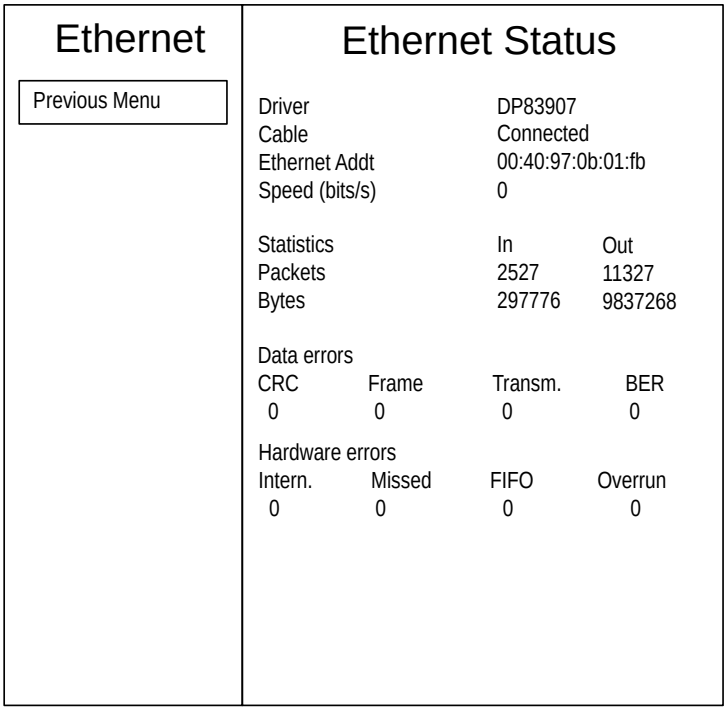


Table 1 Ethernet service data

Value	Usage	Notes
Received packets (***Statistics In/Packets***)	Total number of received packets since last cold start.	
Transmitted packets (***Statistics Out/Packets***)	Total number of transmitted packets since last cold start.	
Received bytes (***Statistics In/Bytes***)	Total number of received bytes since last cold start.	
Transmitted bytes (***Statistics In/Bytes***)	Total number of transmitted bytes since last cold start.	
CRC errors (***CRC***)	Number of received packets with incorrect checksum.	
Frame errors (***Frame***)	Number of received packets with incorrect frame structure.	Refers to physical layer problems. An erroneous packet has often both frame and CRC errors.
Transmission errors (***Transm.***)	Number or errors in packet Transmission.	
BER errors (***BER***)		
Internal errors (***Intern.***)	Internal error of the network board.	Must always be 0.
Missed packets (***Missed***)	Number of received packets lost due to overload.	Must always be 0.
FIFO errors (***FIFO***)	Internal error of the network board.	Must always be 0.
Overrun errors (***Overrun***)	Practically the same as above.	Must always be 0.

3.2.4 Unity Config (in Unity)

Unit Name: It is used for setting the unit name in the monitor. The default unit name is "X".

Bed Name: It is used for setting the bed name in the monitor. The default bed name is the last five characters of the MAC address, excluding the colon delimiter characters

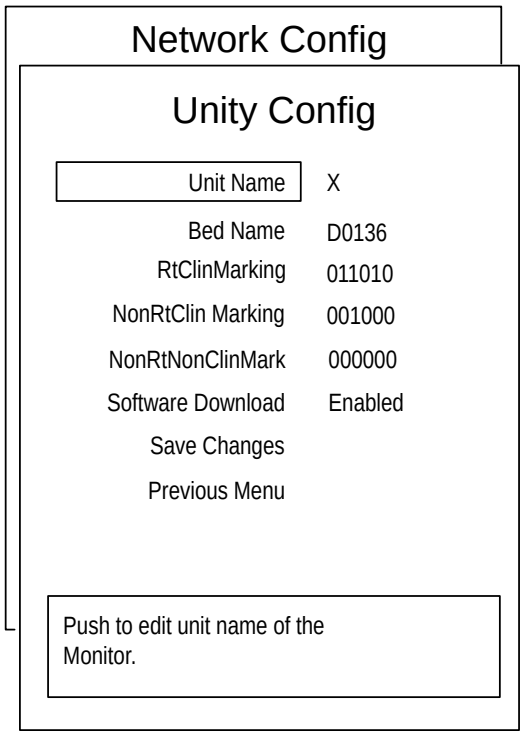
RtClinMarking: It is used for tagging the following outgoing packets with a DSCP marking of 26 (011010): realtime clinical information (waveforms, parameters, alarms), Realtime network control information (time)

NonRtClin Marking: It is used for tagging the following outgoing packets with a DSCP marking of 8 (001000): non-realtime clinical decision support information (Admission, Histories, Full Disclosure, Printing)

NonRtNonClinMark: It is used for tagging the following outgoing packets with a DSCP marking of 0 (000000): non-realtime, non-clinical decision support information (Service, InSite)

Software Download: reserved for future use.

Save Changes: It is gray if the changes have not been done to the menu information.
NOTE: When save changes the monitor will require a restart.



3.2.5 TCP/IP Config

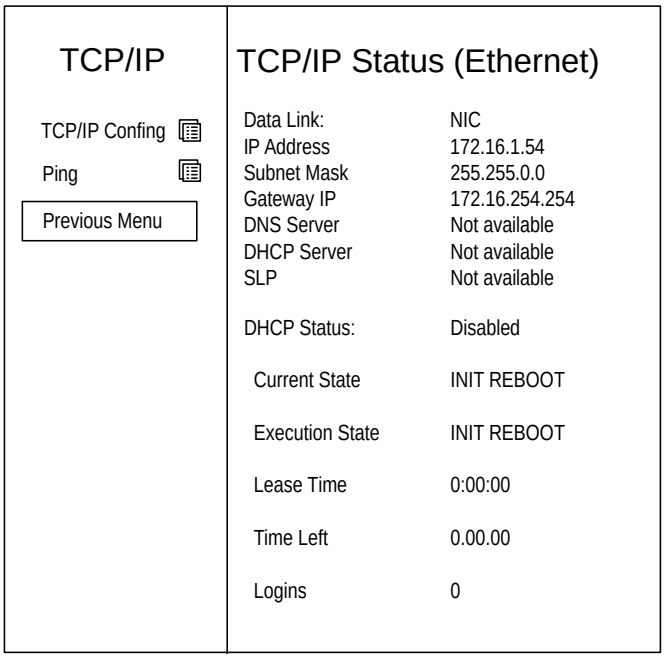
The **TCP/IP Status** view shows the general status of the TCP/IP set up.

Data link: "NIC" for ehternet

The network set up indicates below if the ethernet cable is connected.

DHCP Status: "Disabled" or "Enabled" depending on the DHCP status.

The DHCP status related information displayed below.



TCP/IP config

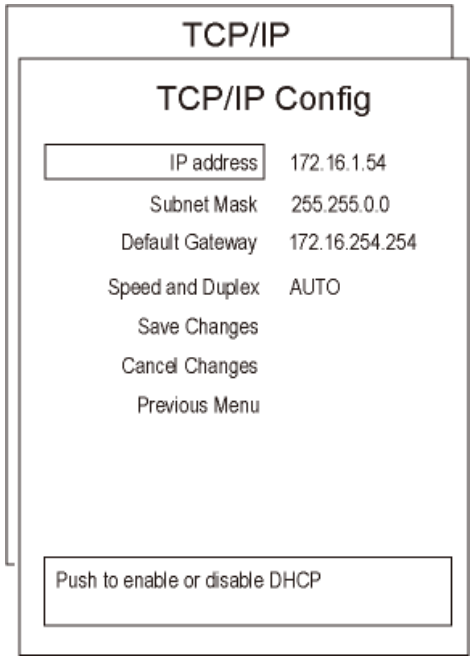
IP address: For setting the static IP address of monitor.
Subnet Mask: For setting the static subnet mask of monitor.

Default Gateway: For setting the static default gateway of monitor.

Speed and Duplex: For setting speed and dupliex of monitor.

Save Changes: Close menu and save the current menu information to permanent memory.

Cancel Changes: Close menu without saving changes



Ping

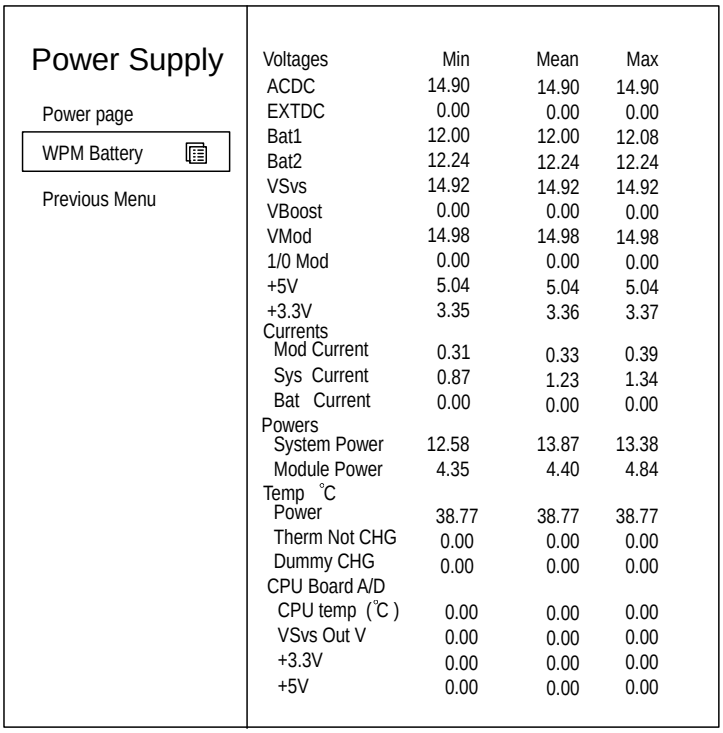
IP Address: For configuring the destination IP address for the ping command.

Ping: Enable the ping command by sending Internet Control Message Protocol (ICMP) echo request packets to the target host and wait for an ICMP response. The response should be show in the ***Ping Status*** view.

3.3 Power supply

The menu shows the voltages and temperature measured by the power board and CPU board. The values in the column under ***Mean*** are the mean values of last one second, the ***Min*** column shows the minimum mean value, and the ***Max*** column the maximum mean value of the voltages and temperature measured during the current power ON.

The voltages and currents are measured by the power Board, except the four lowest under heading CPU Board A/D, which are measured by the CPU Board. +5V and +3.3V values come thus both from the power Board and CPU Board. System power and Module power are calculated by the power Board.



Voltages	Min	Mean	Max
ACDC	14.90	14.90	14.90
EXTDC	0.00	0.00	0.00
Bat1	12.00	12.00	12.08
Bat2	12.24	12.24	12.24
VSvs	14.92	14.92	14.92
VBoost	0.00	0.00	0.00
VMod	14.98	14.98	14.98
1/0 Mod	0.00	0.00	0.00
+5V	5.04	5.04	5.04
+3.3V	3.35	3.36	3.37
Currents			
Mod Current	0.31	0.33	0.39
Sys Current	0.87	1.23	1.34
Bat Current	0.00	0.00	0.00
Powers			
System Power	12.58	13.87	13.38
Module Power	4.35	4.40	4.84
Temp ℃			
Power	38.77	38.77	38.77
Therm Not CHG	0.00	0.00	0.00
Dummy CHG	0.00	0.00	0.00
CPU Board A/D			
CPU temp (℃)	0.00	0.00	0.00
VSvs Out V	0.00	0.00	0.00
+3.3V	0.00	0.00	0.00
+5V	0.00	0.00	0.00

Voltages

ACDC AC/DC converter's output voltage, used as monitor input voltage when the mains cord is connected. Range when present: 15.25...16.55V (Note: this includes the measurement inaccuracy).

EXTDC Not used.

Bat1 Battery A voltage measured at power Board. Range 9...12.6V for Li-ION battery

Bat2 Battery B voltage measured at power Board. Range 9...12.6V for Li-ION battery

VSys System voltage at power board. This is the monitor input voltage measured at the power board after input voltage selection. Range 9...16.5V.

VBoost Not used.

VMod Supply voltage for modules. VBOOST is fed through a circuit breaker to VMOD. Range 13.8...16V.

I/O Mod Not used.

+5V At power board. Range 4.8...5.3V.

+3.3V At power board. Range 3.15...3.45V.

Currents

Mod Current Current from module bus voltage VMOD. Depends on the module configuration.

Sys Current Current from system voltage VSYS. Depends on the system configuration and battery charging.

Bat current Current from or to the battery selected (discharge or charge). Measured at power Board. Depends on the system configuration and battery charging.

Powers

System Power Power from VSYS, calculated by power Board software. System power = VSYS * SYS Current

Module Power Power from VMOD, calculated by power Board software. Module power = VMOD * Mod Current

Temp

Power Power supply unit temperature, measured at power Board.

Therm Not CHGNot used.

Dummy CHG Not used.

CPU Board A/D

CPU Temp Not used.

VSYS_OUT Not used.

+3.3VMeasured at CPU Board. Range 3.15...3.45V.

+5V Measured at CPU Board. Range 4.75...5.25V.

3.3.1 WPM Battery

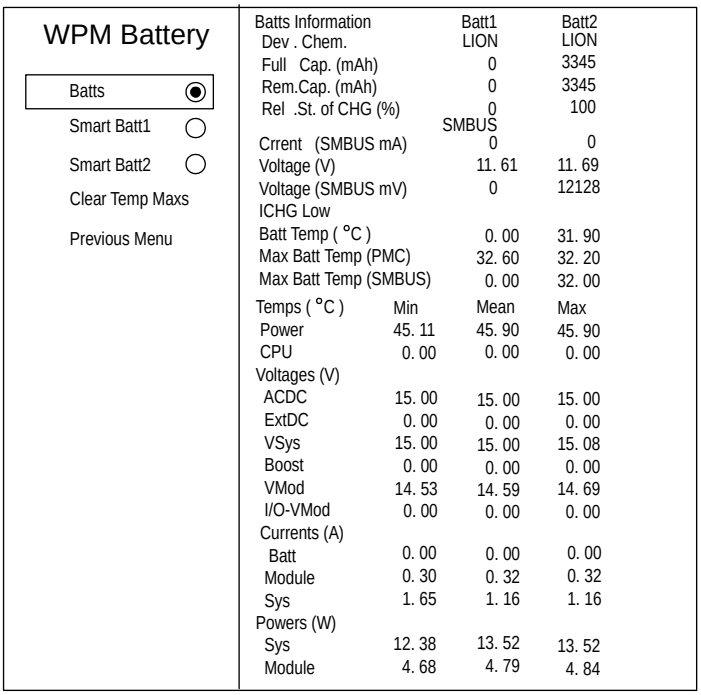
Batts

This page contains information related to the batteries and power supplies. The power supply part is practically the same as in Power Page. Battery information includes also data measured by the smart batteries themselves and transmitted to the power Board via SMBus.

SMBus is System Management Bus, a two-wire interface closely resembling IIC. SMBus is used for battery communication.

Batts information section of the page has two columns: Batt1 for battery A data and Batt2 for battery B data.

NOTE: Text 'SMBus' above Current (SMBus mA) line shows which battery is connected to the SMBus.



Battery information

Dev. Chem. Device chemistry. B40/B20 monitor supports only Li-ION batteries.

Full Cap.(mAh) Full charge capacity of the battery; capacity of the battery when it is fully charged.

Rem. Cap. (mAh) Remaining battery capacity.

Rel. St. of CHG (%) Relative state of charge of the battery. Expressed as a percentage of Rem. Cap. (mAh) / Full Cap.(mAh).

Current (SMBus mA) Battery current (discharge or charge) measured by the battery, transmitted via SMBus to power Board.

Voltage (V) Battery voltage measured at the power Board

Voltage (SMBus mV) Battery voltage measured by the battery.

ICHG Charging power level for charger hardware, this bit can have values high or low. High is the normal setting, low is used when the power Board software determines to limit the total power consumption of the monitor by limiting the charging power (i.e. due to high temperature).

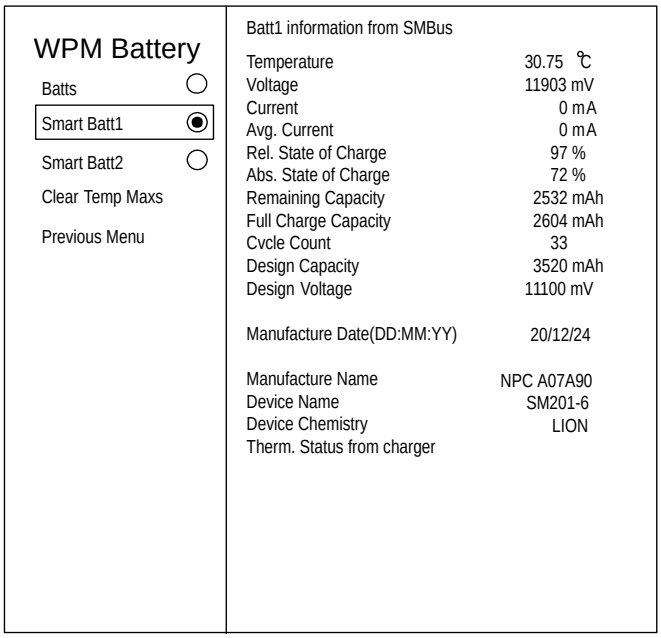
Batt Temp (°C) Battery temperature. This is real time data for the battery connected to SMBus.

Max Batt Temp (PMC) This is subject to change.

Max Batt Temp (SMBUS) Maximum battery SMBus temperature from entering the service pages. Max values are updated in real time for the battery connected to the SMBus.

Other measurements See explanation in the previous power pages.

Smart Batt1



Battx information from SMBus (this information is received from the battery via SMBus)

Temperature: Battery temperature

Voltage: Battery voltage

***Current*:** Battery current (discharge or charge)

Avg. Current: Rolling average of the battery current

Rel. State of Charge: Relative state of charge of the battery. Expressed as a percentage of Rem. Cap. (mAh) / Full Cap.(mAh).

Abs. State of Charge: Absolute state of charge. Expressed as a percentage of Rem. Cap. (mAh)/ Design Capacity (mAh).

Remaining Capacity: Remaining battery capacity (mAh).

Full Charge Capacity: Capacity of the battery when it is fully charged.

Cycle Count: Number of cycles the battery has experienced. A cycle is an amount of discharge approximately equal to the value of Design Capacity. The exact value of cycle count threshold is stored in the battery permanent memory.

Design Capacity: Theoretical capacity of a new battery.

Design Voltage: Theoretical value for nominal voltage of a new battery.

Manufacture Date (DD:MM:YY) : The date the battery pack was manufactured.

Manufacturer Name: Acronym of the battery pack manufacturer name.

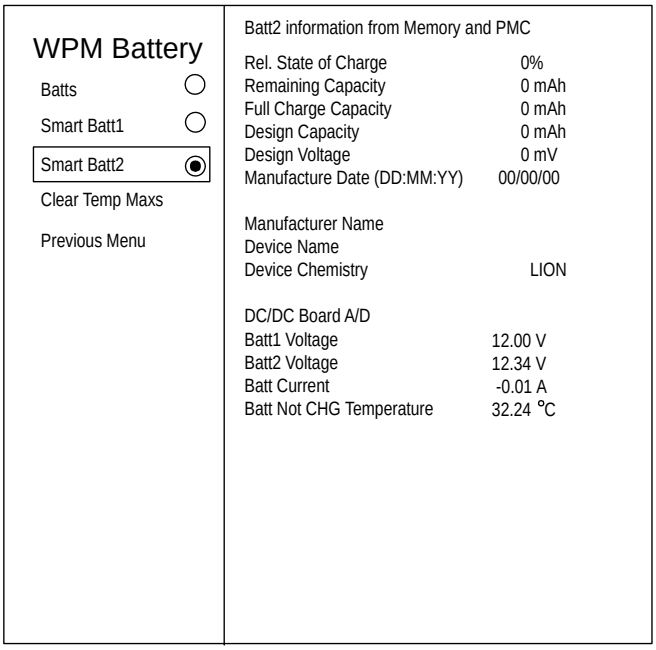
Device Name: Battery pack model name.

Device Chemistry: Battery chemistry of the cells used.

Therm. Status from charger: Status of the battery thermistor or code resistor read by Smart Battery Charger IC. The thermistor or code resistor is always connected to the charger whenever the corresponding battery is connected to the charger and SMBus.

Smart Batt2

If Smart Battx is selected for a battery NOT connected to the SMBus, the menu contains the following:



Battx information from Memory and PMC (This information comes from the power Board memory or is measured by the power Board. SMBus data in this menu is not real time, because this battery is not connected to the SMBus).

NOTE: This page may not contain information if SMBus has been connected only to the other battery. Page can be updated by battery disconnection and reconnection, if desired.

Rel. State Charge: Relative state of charge of the battery. Expressed as a percentage of Rem. Cap. (mAh) / Full Cap.(mAh).

Remaining Capacity: Remaining battery capacity (mAh).

Full Charge Capacity: Capacity of the battery when it is fully charged.

Design Capacity: Theoretical capacity of a new battery.

Design Voltage: Theoretical value for nominal voltage of a new battery.

Manufacturer Date (DD:MM:YY): The date the battery pack was manufactured

Manufacturer Name: Acronym of the battery pack manufacturer name.

Device Name: Battery pack model name.

Device Chemistry: Battery chemistry of the cells used.

Batt1 Voltage: Battery A voltage measured at the power Board.

Batt2 Voltage: Battery B voltage measured at the power Board.

Batt Current: Battery current (discharge or charge) for the battery connected to SMBus. Measured at the power Board.

Batt Not CHG Temperature: This is subject to change.

Clear Temp Maxs

This command is useful only when the WPM Battery Batts view is selected.
The Clear Temp Maxs command clears the maximum values of Batt Temp (SMBus) and Batt Temp (PMC).

Note: Power temp and CPU temp maxs are not cleared.

4 Keyboard

4.1 Keyboard

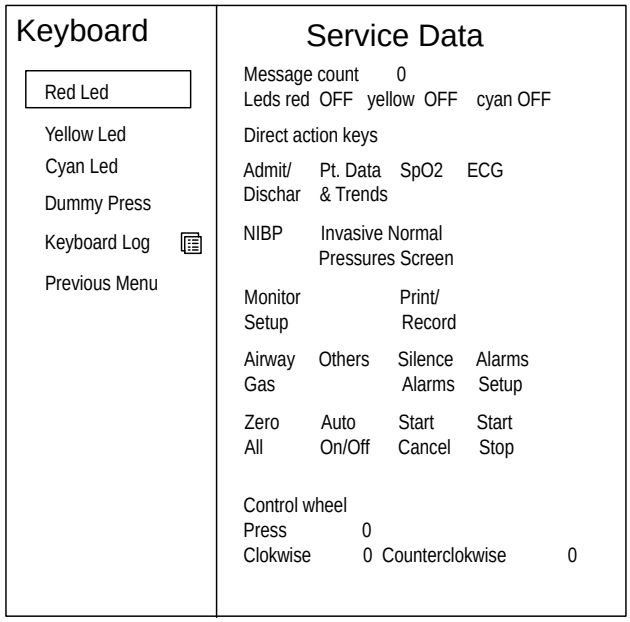
The service menu for testing the command board functions.

Red Led is for testing the red alarm light on the monitor. When the text is highlighted, the red alarm light can be turned on and off by pressing the Trim Knob.

Yellow Led is for testing the yellow alarm light on the monitor. When the text is highlighted, the yellow alarm light can be turned on and off by pressing the Trim Knob.

Cyan Led is for testing the cyan alarm light on the monitor. When the text is highlighted, the cyan alarm light can be turned on and off by pressing the Trim Knob.

Dummy Press is for testing the Trim Knob. When the text is highlighted, pressing the Trim Knob creates a sound from the loudspeaker and the corresponding number on the service data field increases.



Service Data

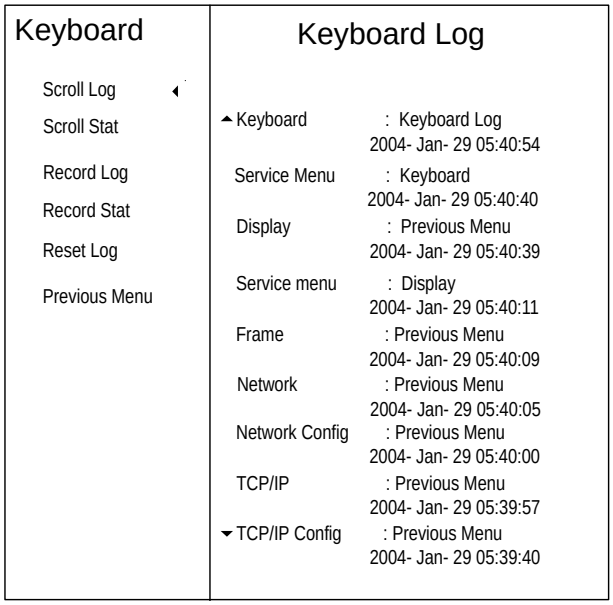
Message Count counts the number of messages that are sent out to the main CPU board.

4.1.1 Keyboard Log

Keyboard Scroll Log

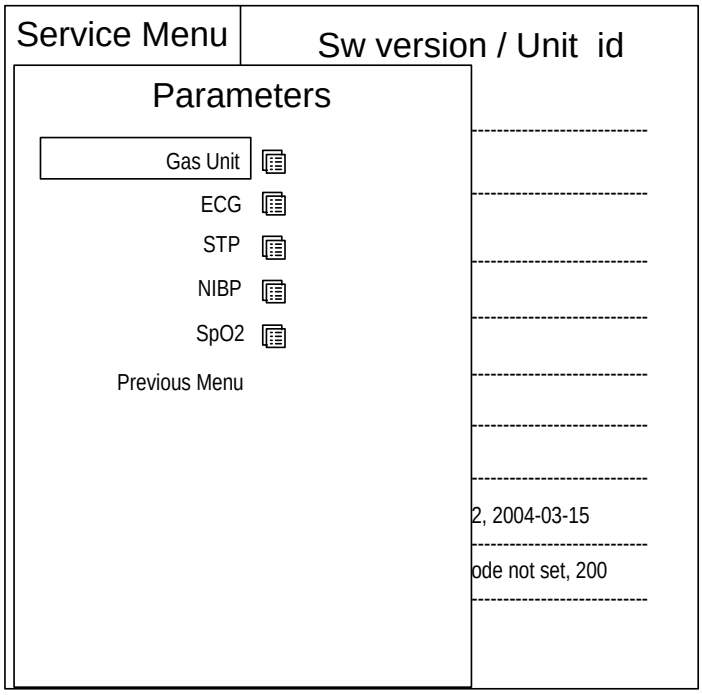
All the keyboard presses and the commands given by the Trim Knob are recorded in the Keyboard Log. The keyboard log is saved in the permanent memory of the monitor. The length of the log is 80 events. The log is FIFO type.

Scroll Stat enables to scroll the keyboard events.



4 Parameters

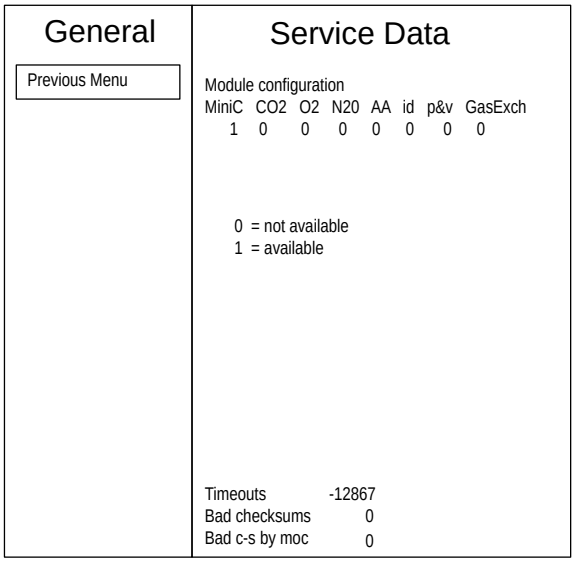
NOTE: Parameter values in Service Data fields are only for reference in this section.



4.1 Gas Unit

4.1.1 General

Service Data



Module configuration shows which measurement options are available, i.e. are detected by the module.

Timeouts is a cumulative number that indicates how many times the module has not responded to the monitor's inquiry.

Bad checksums is a cumulative number that indicates how many times communication from the module to monitor has broken down.

Bad c-s by mod is a cumulative number that indicates how many communication errors the module has detected.

The monitor starts counting these items at power up and resets to zero at power off. The values may also be reset when a module is attached to the monitor frame and be set to 32769 or continuous counting may be started when the module is removed from the monitor frame.

The nonzero values do not indicate a failure, but the continuous counting (more than 5 per second) or value 32769 indicates either a serial communication failure or a module not in place. Also failures in other modules may cause these numbers to rise or be set to 32769.

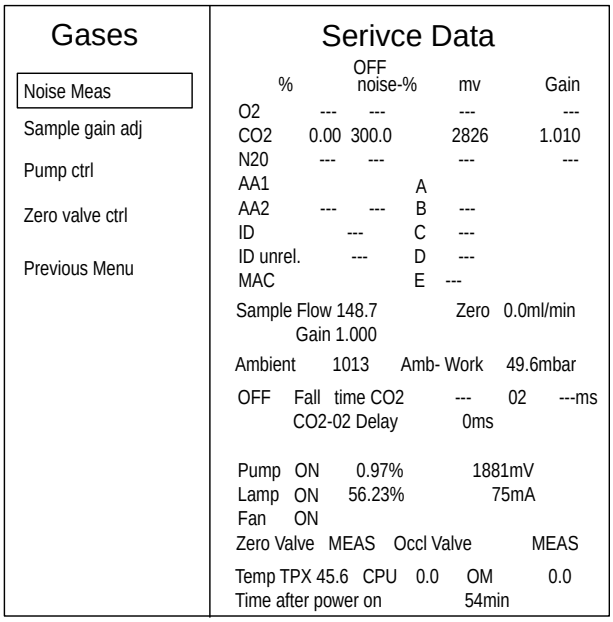
4.1.2 Gases

Noise Meas activates the noise measurement.

Sample gain adj adjusts the sampling pump gain, i.e. for adjusting the sample flow measurement.

Pump ctrl A manual control for the sampling pump.

Zero valve ctrl A manual control for the zero valve.



Service Data

CO_2% field shows real-time concentrations.

CO_2noise-% is standard deviation of concentration.

CO_2 mV field: signal is scaled to mV.

CO_2 Gain: User gain. It is scaled as (User gain)/(Factory gain).

O2, N2O, AA Not in use

ID Not in use

ID unrel. Not in use

MAC Not in use

Sample Flow is calculated from differential pressure and adjusted by the module. **Zero** value as measured during initialization when the pump is off. **Gain**: sample flow measurement can be calibrated by adjusting the gain.

Ambient Ambient pressure is measured continuously. **Amb-Work**: ambient pressure - sampling system internal pressure.

Fall time Not in use

CO_2-O_2 Delay Not in use

Pump Can be toggled ON/OFF. PWM output 0-100% is shown. Pump voltage is also shown.

Lamp The state, PWM control, and current of the lamp are shown.

Fan Not in use

Zero Valve Can be toggled between the measurement state (MEAS) and the zeroing state (ZERO).

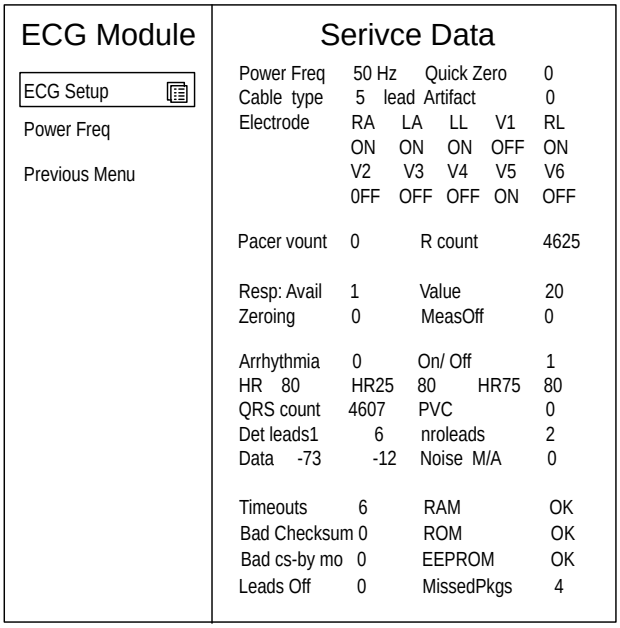
Occl Valve Not in use

Temp Temperatures measured by the module from TPX, CPU, and OM.

Time after power on In minutes after power on.

4.2 ECG Module

Service Data


ECG Module
ECG Setup
Power Freq
Previous Menu
Serivce Data
Power Freq 50 Hz Quick Zero 0
Cable type 5 lead Artifact 0
Electrode RA LA LL V1 RL
ON ON ON OFF ON
V2 V3 V4 V5 V6
0FF OFF OFF ON OFF
Pacer vount 0 R count 4625
Resp: Avail 1 Value 20
Zeroing 0 MeasOff 0
Arrhythmia 0 On/ Off 1
HR 80 HR25 80 HR75 80
QRS count 4607 PVC 0
Det leads1 6 nroleads 2
Data -73 -12 Noise M/A 0
Timeouts 6 RAM OK
Bad Checksum 0 ROM OK
Bad cs-by mo 0 EEPROM OK
Leads Off 0 MissedPkgs 4

Power Freq shows the mains frequency selected: 50 Hz / 60 Hz

Cable type shows the leadwire set connected: 3 lead / 5 lead

Quick Zero shows 1 when the ECG signal is beyond scale, and therefore, is quickly returned to the optimal range with fast signal processing methods.

Artifact shows 1 when artifacts are detected.

Electrode shows ON when each of these electrodes is connected.

Pacer count is a running number of detected pacemaker spikes.

R count is a running number of detected R waves.

Resp: Avail shows if a module with impedance measurement is plugged (1) or not plugged (0) into the monitor.

Value shows the measured respiration rate value for impedance respiration.

Zeroing indicates the zeroing status of the respiration measurement: 1 = zeroing, 0 = not zeroing.

MeasOff shows 1 if the respiration measurement is set to OFF, and 0 if the the respiration measurement is set to ON.

Arrhythmia shows an active arrhythmia alarm (VFIB, VTAC, ASY).

On/Off shows 1 if arrhythmia analysis is active and 0 if it is not active.

HR, HR25 and ***HR75*** for R&D purpose only

QRS count shows the running number of detected QRS complexes.

PVC shows the PVCs detected per minute

Det leads shows the leads that are being used for detecting beats and ventricular fibrillation. The selection of user leads (ECG1, ECG2, ECG3) on the monitor affects the leads used for detection. The first lead used for detection is lead either I or II. The algorithm uses the lead appearing first in user leads. The second lead used for detection is one of the precordial leads (V1 - V6): -1 = invalid (not used), 0 = lead I, 1 = II or III; 2 = V1, 3 = V2, 4 = V3, 5 = V4, 6 =V5, 7 = V6

nroleads shows the number of leads that are beign used for detecting beats and ventricular fibrillation. Possible values include: 0 , 1 and 2 (ref. ***Det leads***) analysis.

Data for R&D purpose only

Noise M/A for R&D purpose only

Timeouts is a cumulative number that indicates how many times the module has not responded to the monitor's inquiry.

Bad checksums is a cumulative number that indicates how many times communication from the module to the monitor has broken down.

Bad c-s by mod is a cumulative number that indicates how many communication errors the module has detected.
The monitor starts counting these items at power up and resets to zero at power off. The values may also be reset when a module is attached to the monitor frame and be set to 32769 or continuous counting may be started when the module is removed from the monitor frame. The nonzero values do not indicate a failure, but the continuous counting (more than 5 per second) or value 32769 indicates either a serial communication failure or a module not in place. Also failures in other modules may cause these numbers to rise or be set to 32769.

RAM indicates the state of the RAM memory.
ROM indicates whether the checksum at the EPROM is in accordance with the one the software has calculated.
EEPROM indicates if the values stored in the permanent memory are valid.
The state is either ***OK***, ***Fail*** or ? (module not in place or a communication error).
LeadsOff indicates whether the monitor can measure ECG even if one or more leadwires are off: 1 = measurement is not possible, 0 = measurement can be done.

MissedPkgs indicates the number of packages missed.

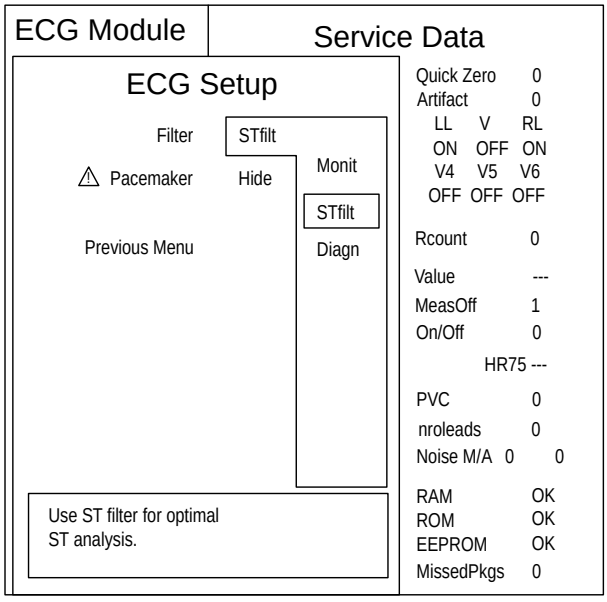
4.2.1 ECG Setup

Filter filters the ECG signal high frequency noise and slow respiratory artifacts:

- ***Monit*** (monitor) filter is used in routine monitoring. It effectively filters the artifacts caused by the electrosurgery unit and respiration.
- ***Diagn*** (diagnostic) filter is used if more accurate information of the waveform is needed (e.g. of P-wave or AV block). The diagnostic filter is more susceptible both to high frequencies and baseline wander than the monitor filter.
- ***STfilt*** (ST filter) permits more accurate information of ST segment. It filters the high frequency artifacts caused by the electrosurgery unit, but catches the slow changes in ST segment. The ST filter is more susceptible to baseline wander than the monitor filter.

Pacemaker selects how to display the pacing pulse of cardiac pacemaker. The selections are ***Show***, ***Hide*** and ***Sensit***:

- ***Hide***: the pacing pulse is filtered away from ECG data.
- ***Show***: the pacer pulse is filtered away from ECG data but the pulse is displayed as a constant height marker.
- ***Sensit:*** uses a more sensitive pacemaker detection. Pacemaker spike is displayed on ECG.

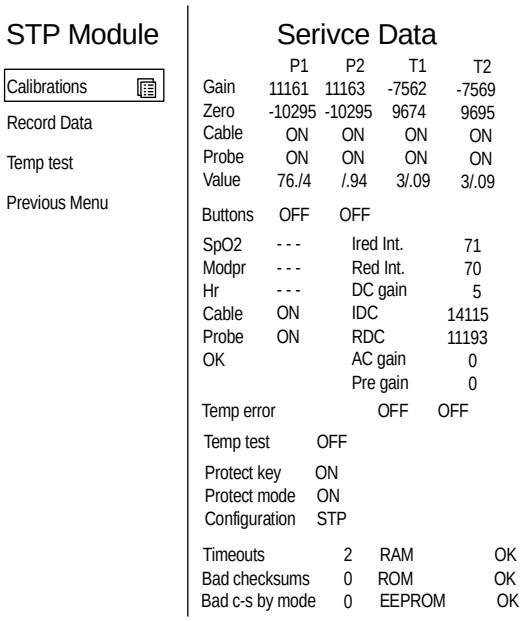


4.3 STP Module (for GE SpO2)

Record Data prints out the shown service data and board information (id, serial number and sw id) onto the recorder.

Temp Test activates the automatic temperature test for the temperature channels T1 and T2. The result from the test is shown in the service data field.

NOTE: The Temp Test needs to be selected twice before the test starts.



Service Data field

Gain is a coefficient to compensate gain error. Usually the values for P1 and P2 are between 17000 and 25000 and for T1 and T2 between 13000 and 14300.

Zero indicates the offset compensation value of each parameter in the A/D converter. Typically the values for P1 and P2 are within ±1000 and for T1 and T2 between -150 and +300. Calibrate if zero and/or gain value is outside the ranges.
Cable shows ON when a corresponding cable is connected to the front panel

Probe shows ON when a corresponding probe is connected to the cable.
Under ***Value*** the measured numeric values are displayed simultaneously. Pressure values are real time values and shown in mmHg. Temperature values are shown in degrees Celsius.

The front panel STP keys functions are confirmed by pressing each key and observing that ***OFF*** turns to ***ON*** at ***Button***.

SpO2 shows the measured beat-to-beat SpO_2 value. ***Modpr*** is a modulation % that indicates the AC/DC ratio in the measured signal. ***Hr*** is a pulse rate calculated from every beat.
Cable and ***Probe*** can be either ***OFF*** or ***ON,*** and these indicate the state PROBE OFF.
Under them there is a message field for SpO_2. It can be OK, PULSE SEARCH, NO PROBE, PROBE OFF, NO PULSE, ARTEFACT, POOR SIGNAL, or CHECK PROBE.

Balance between leds is adjusted by changing the intensity of red/infrared. Intensity of infrared (***Ired Int.***) is in the range of 40 to 255 and red intensity (***Red Int.***) is in the range of 40 to 255.

DC gain shows the gain of DC signal adjusted by the module.

IDC is the value of infrared signal.

RDC is the dc value of red signal.

AC gain is the gain of infrared and red ac signals. AC gain values can be 1 or 0. Value 1 means high ac gain and 0 means low gain.

Pre gain is a preamplifier gain for infrared and red signals. Pre gain values can be 1 or 0. Value 1 means normal operation. Value 0 means that signal levels are very low and extra gain is taken into use.

Temp error shows the status of the temperature test. No errors found show the status (OFF) and errors found (ON).
Protect key and ***Protect mode*** show normally ON but can be turned to OFF for the temperature calibration in Calibration Menu.
Configuration shows the chosen module configuration: T, P, TP, ST, or STP.
Timeouts is a cumulative number that indicates how many times the module has not responded to the monitor's inquiry. ***Bad checksums*** is a cumulative number that indicates how many times communication from the module to the monitor has ***broken down.***
Bad c-s by mod is a cumulative number that indicates how many communication errors the module has detected.
The monitor starts counting these items at power up and resets to zero at power off. The nonzero values do not indicate a failure, but the continuous counting (more than 5 per second) indicates either a serial communication failure, or a module not in place. Also other modules can cause communication errors that cause these numbers rise.

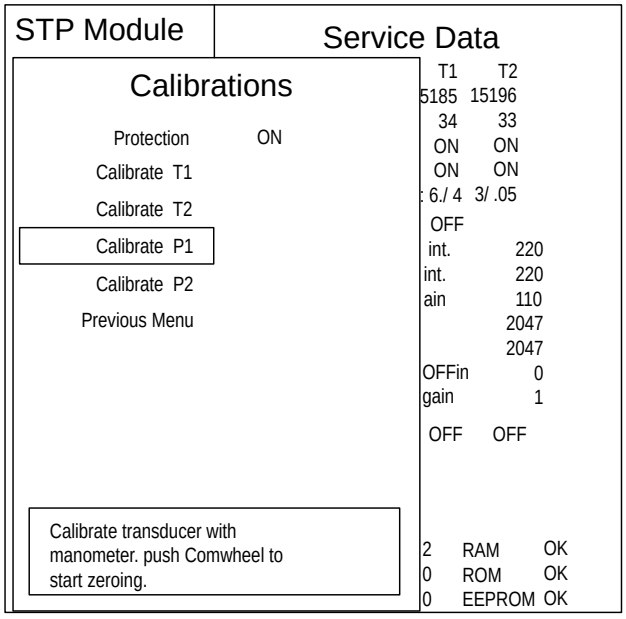
RAM indicates the state of the RAM memory.
ROM indicates whether the checksum at the EPROM is in accordance with the one the software has calculated.
EEPROM indicates if the values stored in the permanent memory are valid.
The state is either ***OK***, ***Fail*** or ***?*** (module not in place or a communication error).

4.3.1 Calibrations

Protection: Protection for the configuration and temperature calibrations can be set ON and OFF.

***Calibrate T1 / Calibrate T2*:** The functions are for calibrating the temperature channels T1 and T2.

***Calibrate P1/ Calibrate P2*:** The functions are for calibrating the invasive blood pressure channels P1 and P2.



How to calibrate T1/ T2

The calibrations are possible only when the protection is set ***OFF***. The temperature calibration requires accurate test plugs of value 25 °C and 45 °C.

1. Select ***Calibrate T1/Calibrate T2***
2. Insert the test plug 25 °C into the T1/T2 connector
3. Press the Trim Knob
4. Insert the test plug 45 °C into the T1/T2 connector
5. Press the Trim Knob

How to calibrate P1/ P2

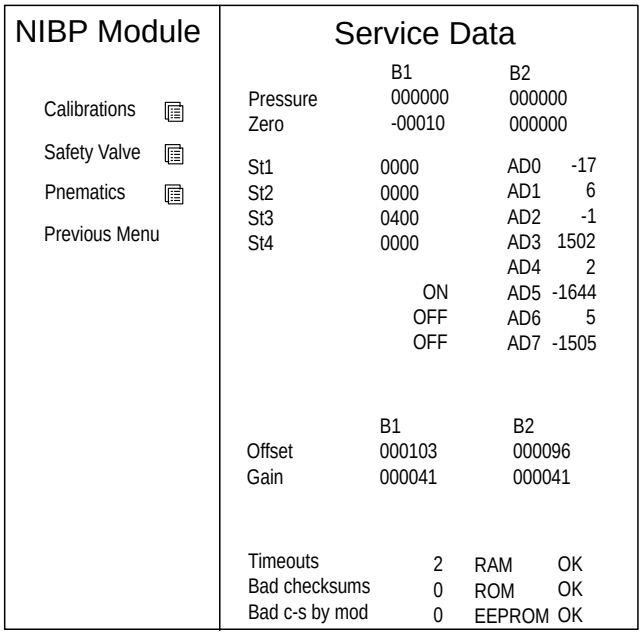
NOTE: Before starting the pressure calibration, disconnect all patient cables and discharge the patient.

The calibrations require a pressure transducer (with appropriate cable) and a pressure manometer.

1. Connect the pressure transducer with the pressure manometer to the P1/P2 connector. Select ***Calibrate P1/Calibrate P2***. Leave the transducer to room air pressure.
2. Press the Trim Knob to start zeroing.
3. Supply a pressure of 100 mmHg to 300 mmHg to the transducer. The recommended pressure is 200 mmHg.
4. Set the pressure on the display to match the pressure reading on the manometer and press the Trim Knob.

4.4 NIBP Module

Service Data



Pressure shows the measured pressure multiplied by 10. This value is automatically zero-drift compensated.
Zero shows the difference between the zeroing value in the permanent memory (stored when the module is calibrated) and the current automatic zero-drift compensation multiplied by 10. The value can change between +20 and -20 mmHg. If the zero drift exceeds ± 10 mmHg, the module should be recalibrated.
AD0 to ***AD7*** show the values of each eight channels of the A/D converter.

ST1: Master status, indicate measurement, calibration, zeroing whether ongoing

ST2: Button status, Not used yet.

ST3: Hardware status, indicate the power supply status, ADC error status.

ST4: Measurement result status, indicate whether measurement is ready, whether cuff ID is updated

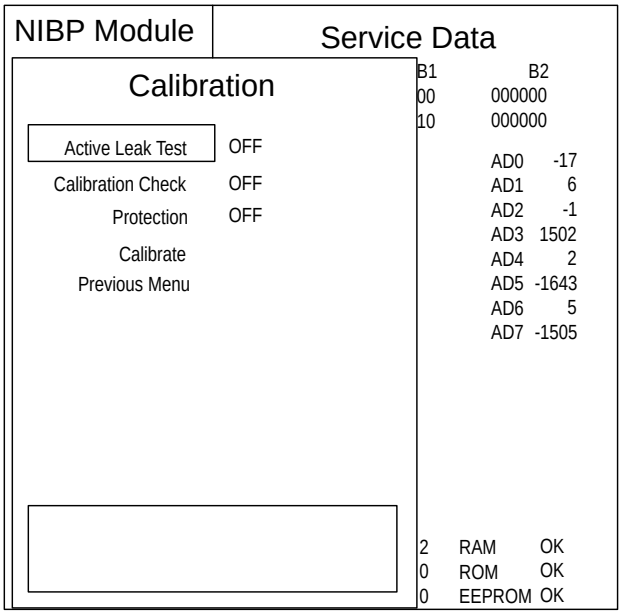
Offset show the offset values for B1 and B2 (pressure sensor calibration factors).

Gain show the gain values for B1 and B2 (pressure sensor calibration factors).
Timeouts is a cumulative number that indicates how many times the module has not responded to the monitor's inquiry.

Bad checksums is a cumulative number that indicates how many times communication from the module to the monitor has broken down.
Bad c-s by mod is a cumulative number that indicates how many communication errors the module has detected.
The monitor starts counting these items at power up and resets to zero at power off. The nonzero values do not indicate a failure, but the continuous counting (more than 5 per second) indicates either a serial communication failure, or a module not in place. Also other modules can cause communication errors that cause these numbers rise.

RAM indicates the state of the RAM memory.
ROM indicates whether the checksum in the EPROM is in accordance with the one the software has calculated.
EEPROM indicates if the values stored in the permanent memory are valid.
The state is either ***OK***, ***Fail*** or ***?*** (module not in place or a communication error).

4.4.1 NIBP Calibration



***Active Leak Test*:** Wrap an adult cuff around a pipe and connect the cuff to the module. Select the active leak test (ON). The module automatically pumps a pressure of 280 mmHg into the cuff. Wait for several seconds until the pressure stabilizes. Then check that the pressure reading does not drop more than 6 mmHg per minute. If it does, leaking point(s) should be detected and fixed. Cancel the test by selecting the Active leak test OFF.

***Calibration Check*:** After the calibration check is selected (ON), the module zeroes the pressure transducers at the beginning of the calibration check. Do not pump pressure until the text 'Zeroed' appears in the NIBP digit field or the zeroing will fail. After the zeroing is done, manually pump pressure into the module and make sure that the same pressure values are shown both on the display and on the manometer. Pressure of both pressure channels B1 and B2 are shown. The pressure values are automatically zero-compensated, so the readings of B1 and B2 should be the same as the manometer readings.

Protection*:** Software calibration protection (ON/OFF). Select ***OFF when calibrating.

How to calibrate

NOTE: Perform NIBP ***Calibration Check*** first to evaluate if calibration is needed or not.

NOTE: Both transducers B1 and B2 will be calibrated simultaneously.

NOTE: The module must be in the frame during the whole procedure.

NOTE: Calibration selection is available only when protection is OFF.

1. Change the ***protection*** setting from ON to OFF to enable the ***Calibrate*** selection - the color of the ***Calibrate*** selection changes from grey to white.
2. Zeroing:
   - Disconnect the NIBP hose from the module connector.
   - Select ***Calibrate*** and push the **Trim Knob.**

NOTE: Messages 'Zeroing' and 'Zeroed' is shown in the NIBP message field and next to the ***Calibrate*** selection momentarily. After this, a pressure bar will appear beside the menu.

3. Calibration:
   - Connect the NIBP hose to the module connector.
   - Connect an external manometer with a pump to both tubes of the hose.
   - Pump about 200 mmHg pressure.

- Verify that both pressure values, B1 and B2, shown in the prompt field of the calibration menu match the manometer reading. If not, adjust the by turning the Trim KnobTrim Knob.
- Press **Trim Knob** to complete the calibration.

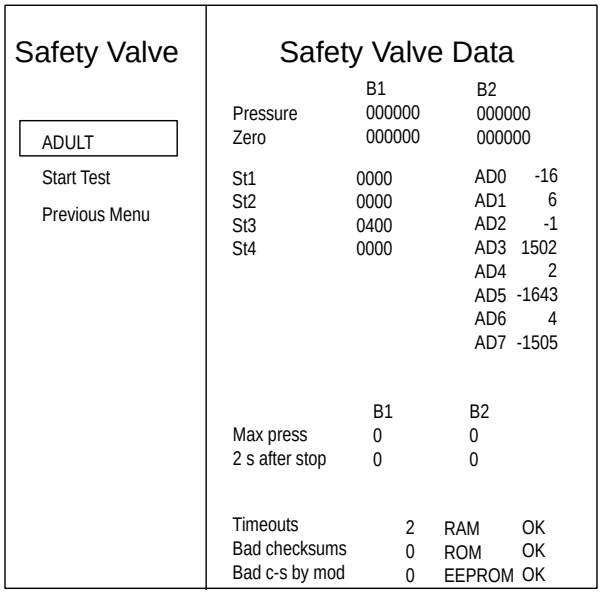
NOTE: Messages 'Calibrating' and 'Calibrated' are shown in the NIBP message field and next to the ***Calibrate*** selection.

NOTE: When calibrating NIBP, always change the displayed pressure value slightly with the Trim Knob, even in cases where the value would be correct. For example, change the value one step higher and then back one step lower. The 'Calibrated' text should appear in the display. This ensures that the calibration procedure is correctly registered and stored by the module.

4. Change the ***Protection*** setting from OFF to ON to disable ***Calibrate*** selection - the color of the ***Calibrate*** selection changes from white to grey.
   NOTE: If a long time not choose ON manually, this menu will automatically return to Protection ON.

4.4.2 NIBP Safety Valve

Start test is for starting and ***Stop test*** for stopping the Safety Valve test.



Safety Valve Data:

For information on general items ***Pressure***, ***Zero***, ***St1*** to ***St4***, ***AD0*** to ***AD7*** as well as ***Timeouts*** etc., see service data descriptions in section 4.4 NIBP Module.

Max. press and ***2 s after stop*** show the measured values at Safety Valve test.

How to do safety valve test

1. Disconnect the pressure manometer from the NIBP cuff connector. Connect the NIBP hose and cuff to the NIBP cuff connector.
2. Connect a standard adult cuff around some round object, for example a calibration gas bottle.
3. Perform a NIBP test by pressing **NIBP Start/Cancel** button (Waiting until the test ended).
4. Select ***Start Test***. Start the adult safety valve test by pressing the Trim Knob. Wait until the pump stops and the pressure is deflated.
5. Check the pressure values 'Max press' for both transducers. All the values should be within 300 - 330 mmHg.
6. Connect a neonatal hose and cuff around another round object, for example a calibration gas bottle.
7. Perform a NIBP test by pressing **NIBP Start/Cancel** button (Waiting until the test ended).
8. Select ***Start Test***. Start the neonatal safety valve test by pressing the Trim Knob. Wait until the pump stops and the pressure is deflated.
9. Check the pressure values 'Max press' for both transducers. All the values should be within 150 - 165 mmHg.
10. Return to the normal monitoring mode by pressing **Normal Screen.**

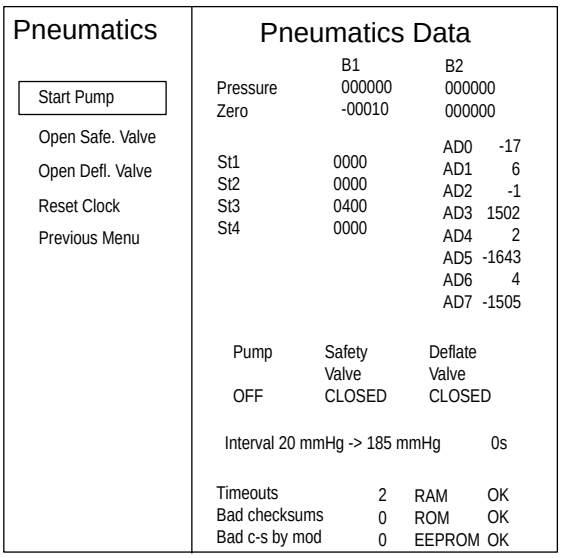
4.4.3 NIBP Pneumatics

Start Pump/Stop Pump*:** A manual control for the pump. The selection changes to ***Stop Pump when the pump turns on.

Open Safe. Valve/Close Safe. Valve*:** A manual control for the Safe valve. The selection changes to ***Close Safe Valve when the valve is opened.

Open Defl. Valve/Close Defl. Valve*:** A manual control for the deflation valve. The selection changes to ***Close Defl. Valve when the valve is opened.

Reset Clock: Set up the Interval time 20 mmHg -> 185 mmHg to 0 s



Pneumatics Data field

For information on general items ***Pressure***, ***Zero***, ***St1*** to ***St4***, ***AD0*** to ***AD7*** as well as ***Timeouts*** etc., see section "NIBP Module."

Pump, ***Safety Valve***, and ***Deflate Valve*** show their states.

How to check Interval 20 mmHg -> 185 mmHg

Select ***Start pump*** at different combinations of the valves open/closed and push the Trim Knob. The module counts the time it takes for the pressure to go up from 20 mmHg to 185 mmHg and displays it. When all the valves are closed, the pump should be able to pump the pressure in about 1 to 4 seconds into an adult cuff wrapped around a pipe. The pump does not stop without selecting ***Stop Pump*** by pushing the Trim Knob.

NOTE: To redo the test, must go back to the previous menu.

4.5 SpO2 (for Masimo/Nellcor SpO2)

PR: Measured pulse rate value

SpO2%: Measured SpO2 value

NoProbe: If there is a probe connected

PulseSearch: If the pulse search is being done.

CheckProbe: If there is check probe error.

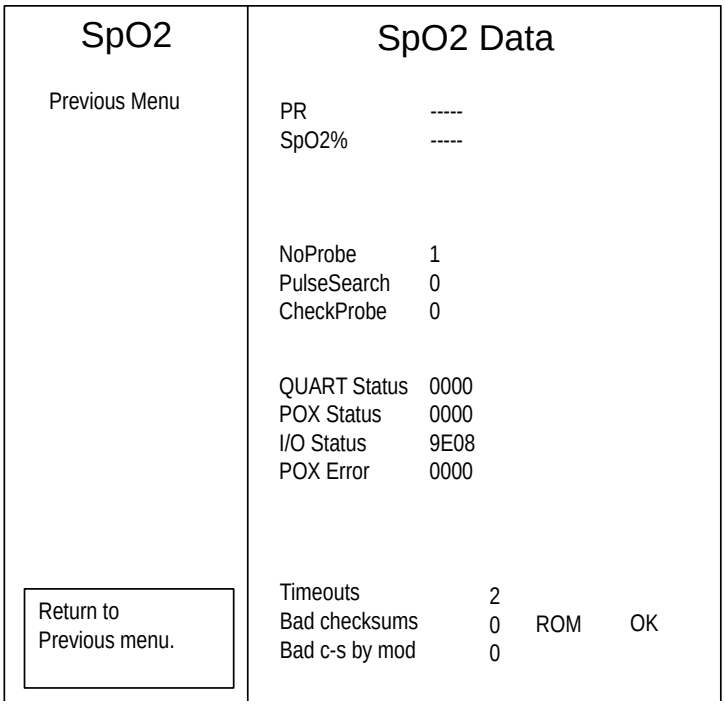
QUART Status: Show quart status.

POX Status: Show POX measurement status.

I/O Status: Show IO status.

POX Error: Show POX error status.

For information on ***Timeouts*** etc., see section "NIBP Module."



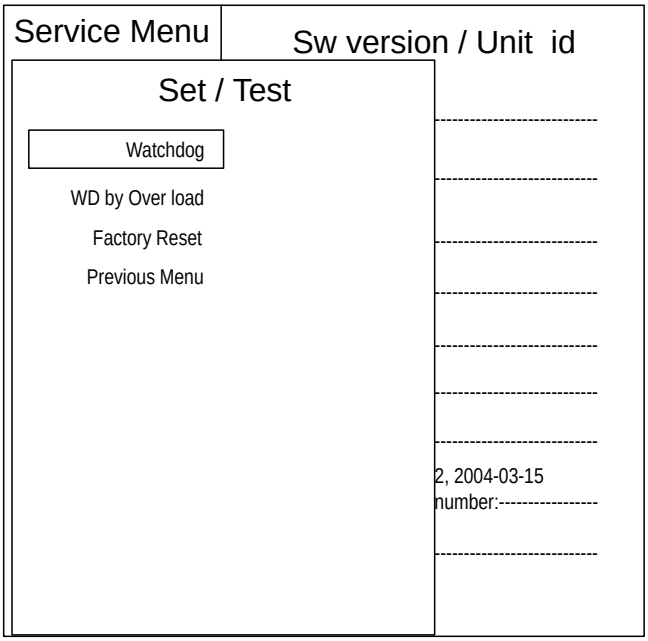
5 Set/Test

The system contains a watchdog circuitry, which needs refreshment at every 10 seconds. If the refreshment did not occur, the watchdog will reset the main CPU.

The purpose of the watchdog is to restart the monitor, if there was a serious malfunction. This feature is useful in two cases: when the main CPU is not able to control the monitor, or when the CPU controls the monitor but detects a serious malfunction. Watchdog tests check proper functionality of the watchdog in various conditions.

Watchdog test ensures directly that the watchdog functions properly. Choosing this test prevents the watchdog from refreshing and shows running seconds with an accuracy of 0.1 seconds.

The test should have the following result when the watchdog is working properly: The monitor will restart after 10 seconds from the start of the test. In malfunction: '>20 s' is displayed. In this case, the fault is in the watchdog.



WD by Overload test ensures the functionality of a feature, where the software controls the monitor, but detects an overload situation in the main CPU.

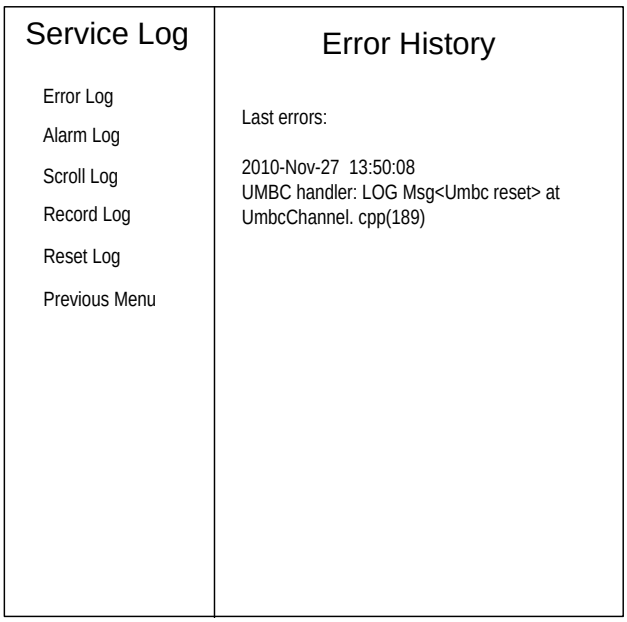
The test should have the following result when the feature is working properly: The monitor will restart after 10 seconds from the start of the test.

Factory Reset restores the factory default settings and clears the data memories. Factory reset should be run if the monitor software is replaced or if the Timekeeper battery is replaced.

6 Service Log

Error, event and alarm data is stored in the Service Log.
The service log contains information about the occurred monitor errors, events and alarms since the last factory reset or service log reset.

Error Log is for selecting the error history view onto the right side of the menu. Error Log shows also some monitoring events like warm and cold starts.
Alarm Log is for selecting the alarm history view onto the right side of the menu.
Scroll Log is for scrolling the error/alarm information on the right side of the menu.
Record Log is for recording the service log information onto the recorder.
Reset Log is for clearing up the content of the selected service log. This function should be run after a performed maintenance.

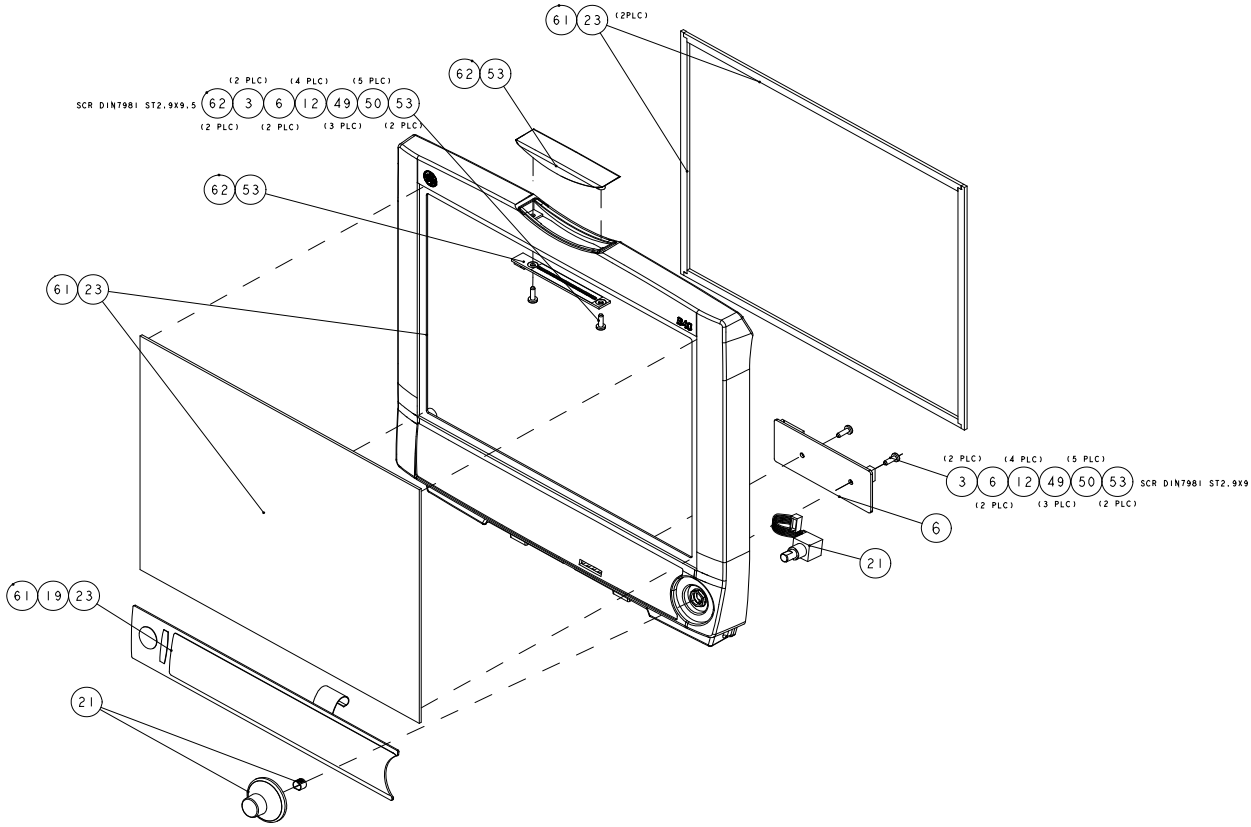


6 Field replaceable unit

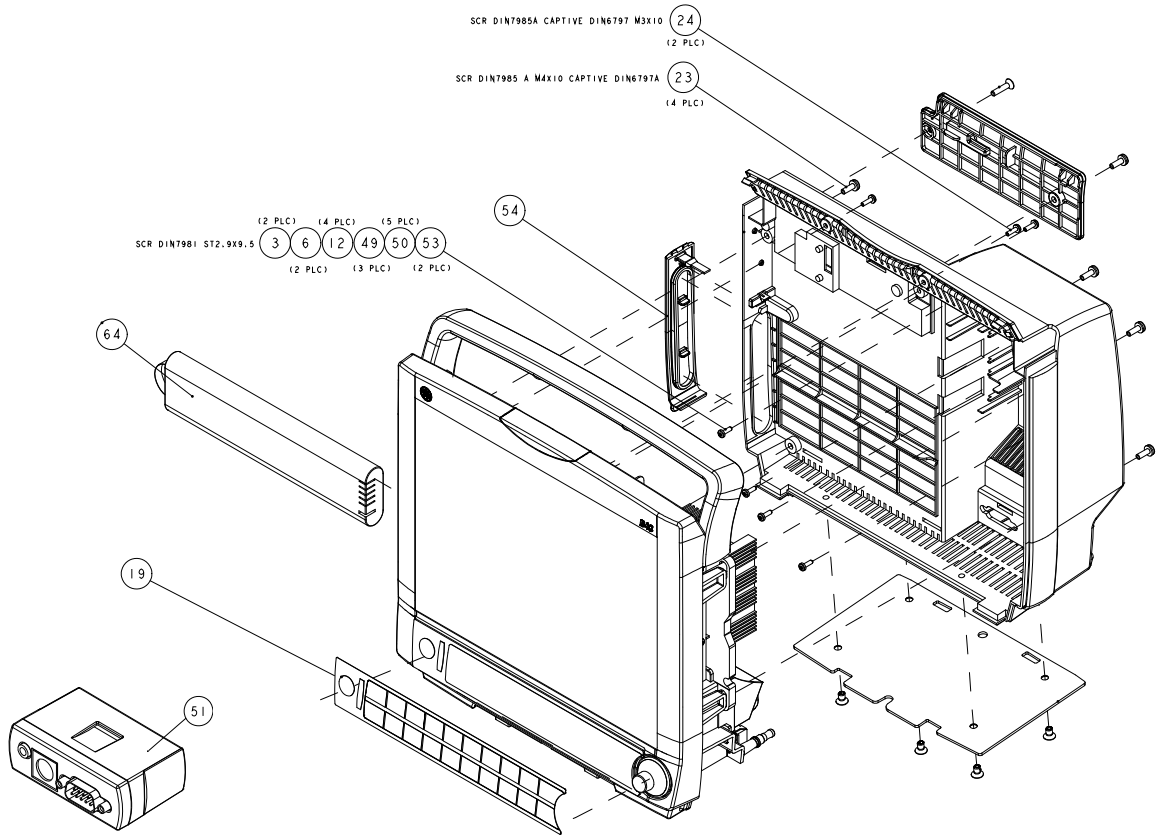
1 Spare part

The following B40/B20 parts will be available as field replaceable spare parts.

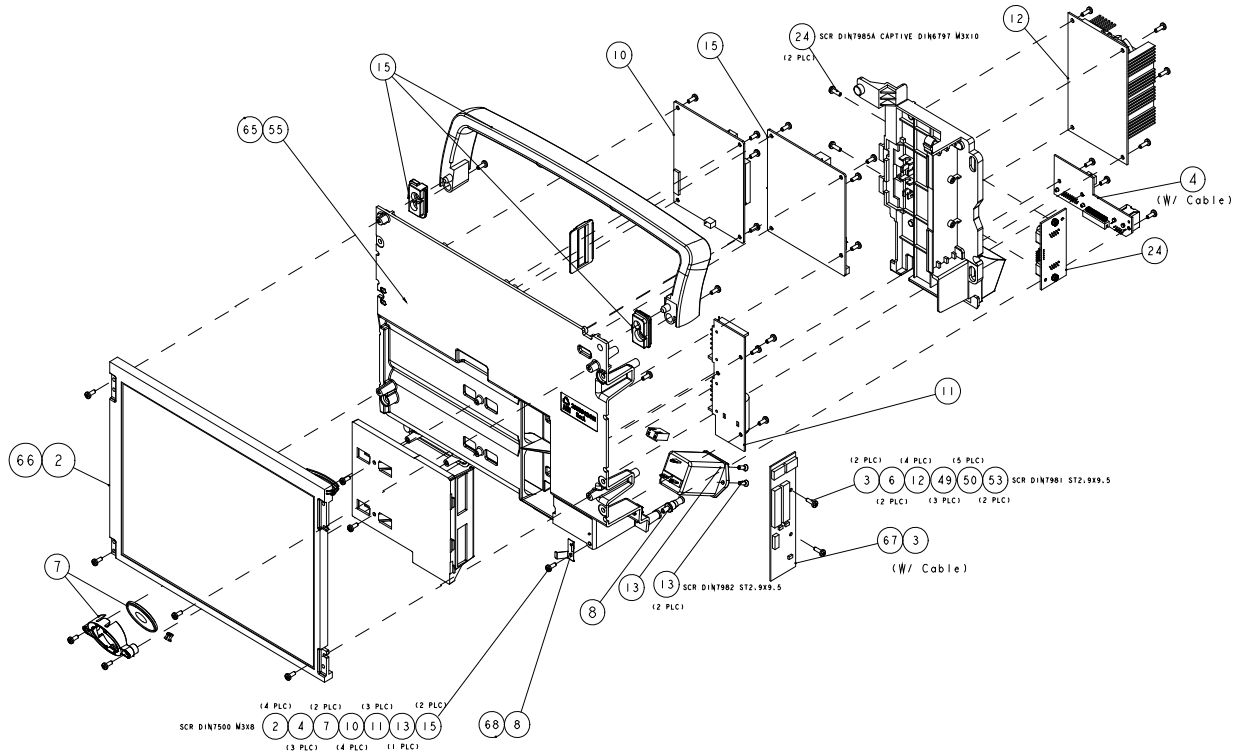
1.1 Front cover



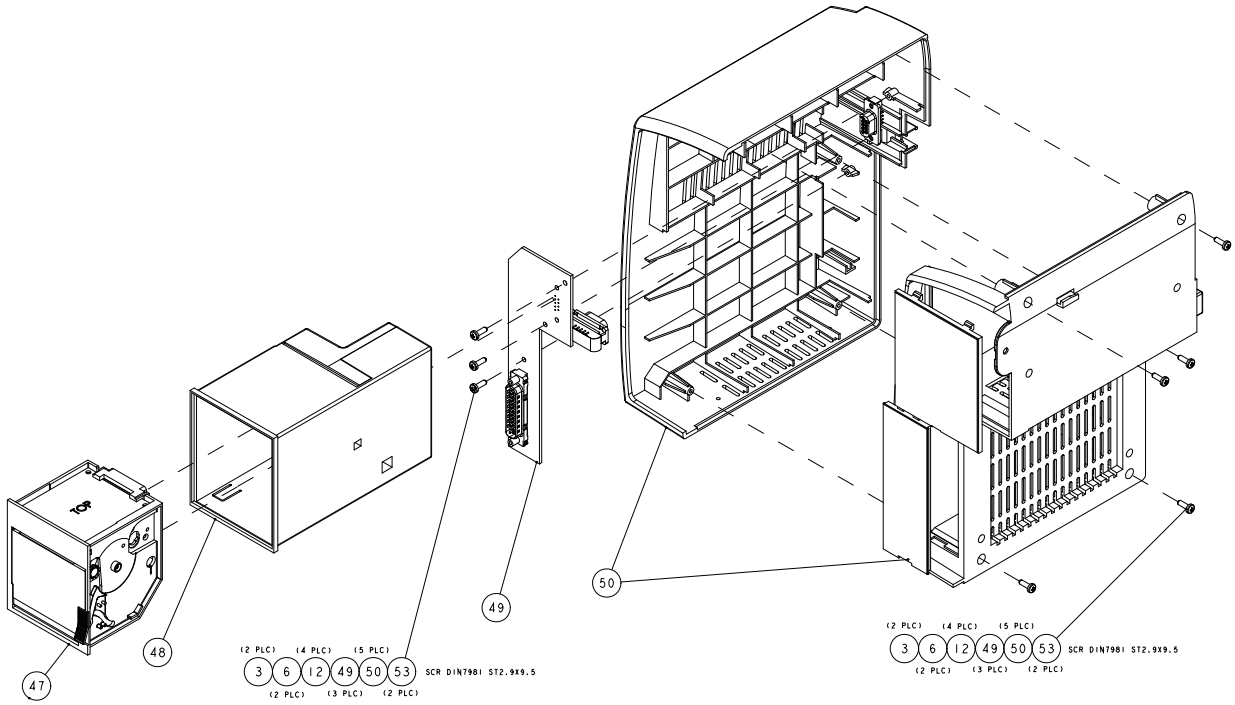
1.2 Back cover unit



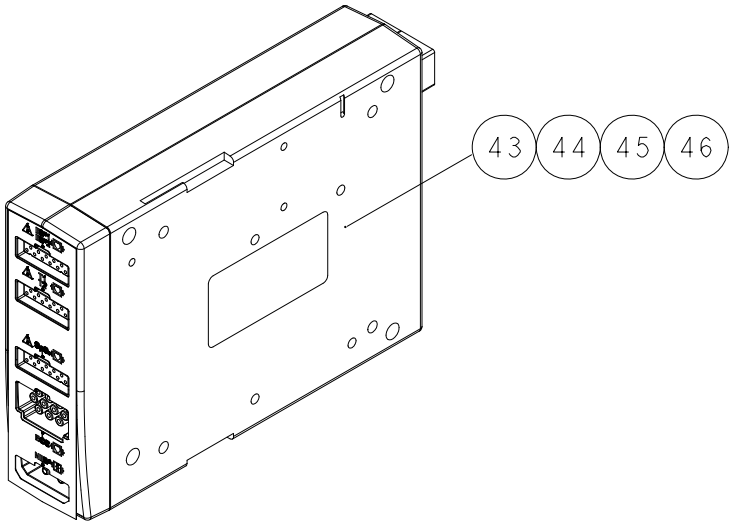
1.3 Frame



1.4 Extension rack



1.5 Hemo box



1.6 FRU parts list

Item	Description	Order Code
2	FRU B40 LCD MODULE	2053489-002
3	FRU B40 LCD Inverter	2053489-003
4	FRU B40B20 ethenet board	2053489-004
6	FRU B40B20 user Interface board	2053489-006
7	FRU B40B20 Speaker	2053489-007
8	FRU B40 Frame cables and mechenical parts	2053489-008
10	FRU B40B20 DC-DC board	2053489-010
11	FRU B40B20 battery board	2053489-011
12	FRU B40B20 AC/DC unit	2053489-012
13	FRU B40B20 AC inlet	2053489-013
15	FRU B40B20 Handle	2053489-015
19	FRU B40B20 keyboard	2053489-019
21	FRU B40B20 Trim Knob	2053489-021
23	FRU B40 FRONT COVER	2053489-023
24	FRU B40B20 Module interface board	2053489-024
43	FRU B40B20 Hemo Nellcor	2053489-043
44	FRU B40B20 Hemo Masimo	2053489-044
45	FRU B40B20 Hemo GE STP	2053489-045

Item	Description	Order Code
46	FRU B40B20 Hemo GE SpO2	2053489-046
47	FRU DASH2500 PRINTER	2023852-008
48	FRU B40B20 Recorder connect board	2053489-048
49	FRU B40B20 RAC flex cable	2053489-049
50	FRU B40B20 RAC cover	2053489-050
51	FRU B40B20 Adapter	2053489-051
53	FRU B40 ALARM LIGHT	2053489-053
54	FRU B20B40 BATTERY COVER	2053489-054
55	FRU B40 MAIN CHASSIS	2053518-055
61	FRU B20 FRONT COVER	2053518-008
62	FRU B20 ALARM LIGHT	2053518-010
64	FRU DASH 2600 BATTERY	2044978-004
65	FRU B20 MAIN CHASSIS	2053518-011
66	FRU B20B30 LCD MODULE	2044978-001
67	FRU B20B30 LCD Inverter	2044978-002
68	FRU B20 Frame cables and mechenical parts	2053518-004

1.7 Other parts

Item	Description	Order Code
-	CABLE RS232 0.76 M NOTE: Please bug this part locally. MPN: CS2N9MF-2.5	2025963-001

2 Disassembly

WARNING **A short circuit may cause internal damage. Do not touch any exposed wiring or conductive surface inside, this may cause an electric shock.**

CAUTION Perform leakage current measurement whenever service or repair has been done in the monitor.

NOTE: The backlight circuit runs on high voltage.

Do not touch the inverter board or the backlight tube leads when powered.

NOTE: Field repairs are recommended to the field replaceable unit (FRU) only. Attempting a field repair on a factory sealed component or assembly could jeopardize the safe and effective operation of the Monitor.

2.1 Before disassembly

NOTE: Wear a grounded, antistatic wristband when handling PC boards. Electrostatic discharge may damage components on the board.

Make sure that the monitor is turned off.

Disconnect from the network.

– Remove the E-miniC module, batteries and power cord first.

2.2 Tools needed

- Screwdrivers; PH2, PO1, PH1, Hex 5.5 (recommend the length > 65 mm)
- Flat blade screwdriver 3 mm
- Antistatic wristband

NOTE: GE recommends that you assemble the monitor using the NEW fasteners (screws, washers, etc.) provided in the FRU kits. Some fasteners, like the screws with a thread locking coating, are NOT intended to be re-used more than three times.

2.3 To separate the frame

To separate the extension rack, hemo module and multi I/O from the frame

1. Remove the 2 screws from the bottom of the frame
   NOTE: When place the monitor face down, be careful of the screen and the Trim Knob.

2. Remove the screw beside the monitor

3. From the back side of the monitor, pull the extension rack out of frame, grasp it firmly.

4. Open the battery's cover, use a screwdriver to release the latch by pivoting the screwdriver away from the monitor. NOTE: Using the 3 mm Flat blade screwdriver into the small hole inside, pull the latch to the screen side.
5. Using the screwdriver to pry the module from the monitor at the same time.
6. Pull the hemo module out of the monitor.

7. Use the screwdriver to prize, pulling out the multi I/O at the same time.

2.4 To disassemble the frame

To open the back cover of the frame

8. Remove the 4 screws from the back side of the frame

9. Remove the 2 screws from top of the frame

10. Open the cover in the back side of the frame, then remove 2 screws inside.

11. Lift the back cover up

To change the handle

After opening the back cover

- Remove 2 screws for the handle.

To remove the front cover

- Remove 4 screws by the side of the frame

- Disconnect the alarm light cable
- Disconnect the connection cable

- Open and remove the front cover from the frame

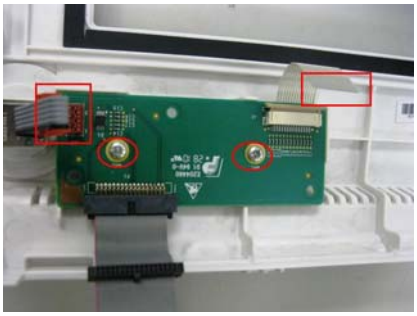
To remove the alarm light board

After opening the front cover

- Remove 2 screws, the alarm light board is on the top of the front cover.

To remove the user interface board

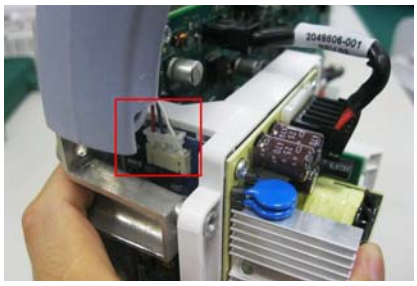
After opening the front cover



- Remove 2 screws, the user interface board is on the bottom of the front cover
- Disconnect the Trim Knob cable
- Disconnect the keyboard/membrane switch cable

To separate the LCD display

- Remove 4 screws from beside the LCD



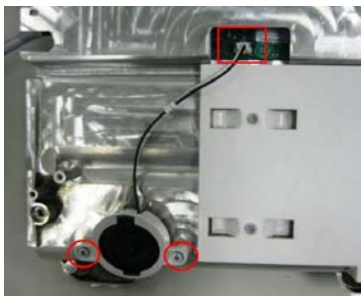
- Disconnect the LCD inverter cable on the top side of the screen

- Disconnect the display cable from CPU board, on the bottom side of the screen
- Remove the LCD display

NOTE: When reassemble the LCD display, be careful that no dirt or finger prints are left.

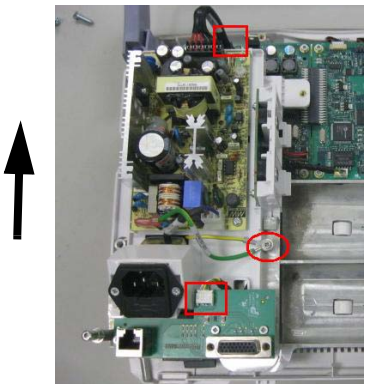
To remove the loudspeaker unit

After removing the LCD display

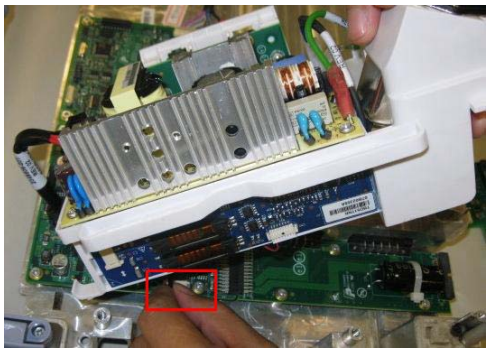


- Disconnect the cable from CPU board
- Remove 2 screws for the loudspeaker

To remove the ACDC unit



- Remove screw
- Disconnect the cable to power board.
- Disconnect the cable to ethenet board
- Slightly lift the front of the ACDC unit, push the whole ACDC unit to top direction.



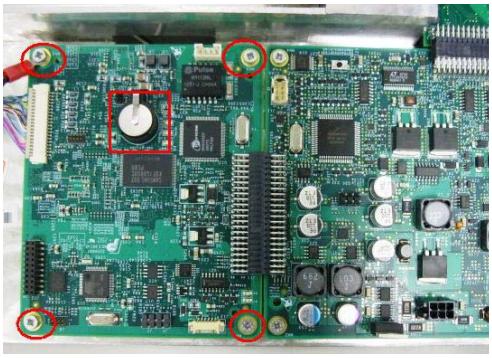
- Lift the unit up
- Disconnect the cable to power board

- Disconnect all the rest cables from the CPU board
- Separate the whole unit from the frame

To remove the ethenet board

- Remove 3 screws for ethenet board
- Lift up the ethenet board from the frame

To remove the CPU board

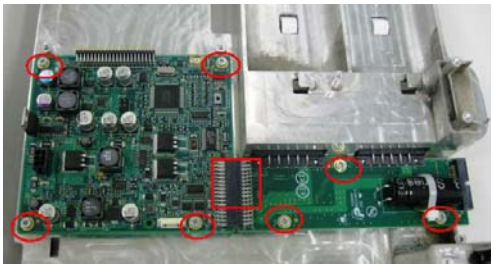


- Remove 4 screws for the CPU Board

NOTE: Replace the CPU battery every 5 years.

- Carefully disconnect the CPU board from the power board, and remove it out.

To remove the power board and battery board



- Remove the rest 7 screws off
- Carefully disconnect the CPU board from the power board, and remove it out first
- Remove the battery board out of the frame

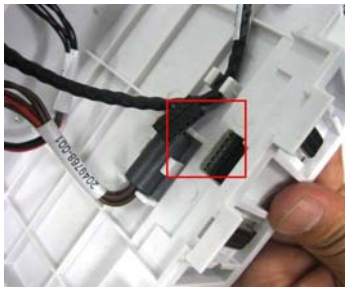
To remove the LCD inverter board

- Remove the 2 screws and separate the board from the unit

To remove the ACDC unit

- Remove the four screws in ACDC unit
- Disconnect the cable from the AC inlet
- Lift up ACDC unit

To remove the module interface board



- Disconnect the cable from from the module interface board

- Remove 2 screws and then remove the module interface board

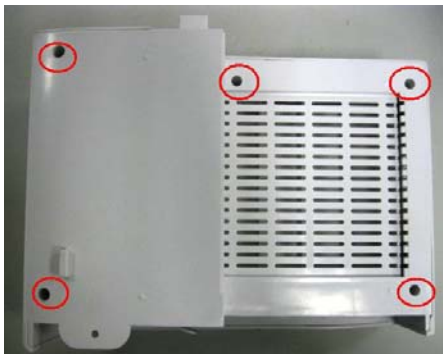
2.5 To disassemble the extended rack and the recorder

To remove the recorder

- Use the flat blade screwdriver to press the lock through the hole inside.

- Pulling the recorder out at the same time

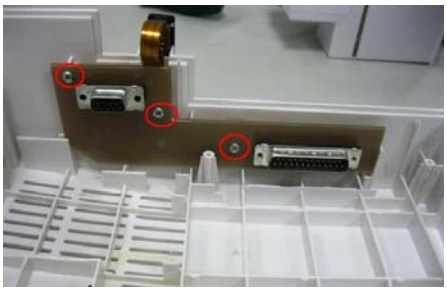
To open the extended rack box



- Remove the 5 screws on the box

- Lift the cover up

To remove the rac flex cable



- Remove the three screws, then remove off the board

To disassemble the recorder

- Remove the paper from the recorder
- Remove 2 screws inside the recorder

Reassemble the module in reverse order.

2.6 Handling and storage of LCD display component

Handling of LCD display component and protective window

If the LCD Display component surface becomes dusty, wipe it gently with absorbent cotton, chamois or other soft material. If necessary, breathe onto the display surface and wipe immediately. The display surface may also be cleaned using a small amount of normal hexane. Do not use acetone, toluene or alcohol because they cause chemical damage to the polarizer.

1. Wipe off saliva and water drops as soon as possible. Their prolonged contact with the polarizer cause deformations and color fading.
2. Do not open the component case because internal circuits are sensitive to electrostatic discharges.

Placing a spare part LCD Display component or a display shield into use:

Peel off the protective film slowly (in more than 10 seconds) from the display or protective window surface. Fast peeling may generate enough static electricity to destroy the LCD Display component.

Storaging an LCD display component as a spare part for a long period

1. Store the display in a dark place. Do not expose it to sunlight or fluorescent light. Keep the temperature between -30 °C and 85 °C / -22 °F and 185 °F at 5% to 95% humidity.
2. The polarizer surface should not come into contact with any other object. It is recommended that the display unit is stored in the container in which it was originally shipped.

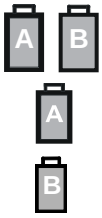
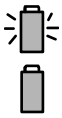
2.7 Batteries

2.7.1 Battery indicators

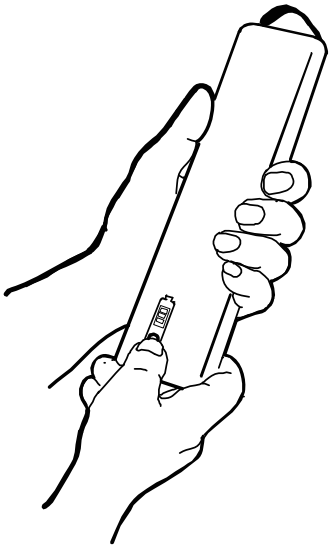
The B40/B20 messages, screen symbols and the LED indicators tell the user about the status of the batteries. For screen symbols, see “Part 1 Symbols”. For LED indicators, consult the table below and for messages, see section “Troubleshooting.” in User’s Guide.

The Green main LED will indicate that monitor is powered by Main. The Green battery LED will indicate that monitor is powered by battery. The Orange battery LED lit will indicate that the battery is in charging. The Orange battery LED flashing will indicate that the battery is defect. If the battery is fully charged and it’s main powered. the orange and Green battery LED will both dark.

Table 12 Battery indicators

Screen symbol	Explanation	Front panel battery LED indicators	
	Monitor is battery powered. Batteries are fully charged and the size of the green bar indicates the charging level.		Orange dark Green lit
	Monitor is battery powered. Battery A is empty, battery B is ok.		Orange dark Green lit
	Monitor is battery powered. Battery A failure, battery B is ok.		Orange flashing Green lit
NOTE: If both batteries fail, the green battery LED is dark.			
	Monitor is mains powered. Battery A is being charged (white bar), battery B is already charged.		Orange lit Green dark
no screen symbol	Monitor is mains powered.		Orange dark Green dark

2.7.2 To check the battery



Check the battery charging level by pressing the test button on the battery as indicated in the drawing on the left.

The green bar lights up and the number of lit segments indicates the charging level: the more lit segments, the higher the capacity level.

Figure 1 Capacity indicator on the battery

2.7.3 Conditioning the batteries

Condition the batteries regularly to maintain their useful life. Condition a battery every six months or when the message 'Condition Battery x'' appears on the screen. Always observe the messages and symbols on the screen to see the battery status. You can also check the status through **Monitor Setup** - ***Battery Setup***. Conditioning a battery is best done on an external charger. If you do not have an external charger, proceed according to the following instructions.

NOTE: You cannot condition batteries during patient monitoring. Always disconnect the modules first.

1. Continue normal battery use until the green bar of a battery charge indicator is less than 3/4 of the full height. After this, remove the battery. Continue monitoring with one battery until its charge is less than 3/4 of the full capacity.
2. Insert both batteries and connect the monitor to the power supply. The monitor starts charging both batteries, and the capacity indicators scroll accordingly. Keep charging the batteries until both capacity indicators are full height.
3. Continue charging for another two hours. After this, check that the orange battery LED in the front panel is no longer on. If it is, continue charging until it goes off.
4. Disconnect the monitor from the power supply and leave it on until the batteries run out and the monitor switches off. Wait for another 15 minutes.
5. Reconnect the monitor to the power supply and turn it on. Continue charging the batteries until both capacity indicators are full height and no longer scrolling.
6. Keep charging for another two hours. After this, check that the orange battery LED in the front panel is no longer on. If it is, continue charging until it goes off to indicate that the battery conditioning is complete.

2.8 To replace the fuses

Pull out the fuse holder under the mains connector at the back of the monitor. Replace the fuses with fuses of exactly the same type and rating.

To change the fuses

- Use the screwdraft to press the fuse holder

- Prize and pull the holder out
- Replace the fuse with correct type and rating

2.9 To download the software

Refer to the instruction in Software's FRU, follow the instruction for downloading service software.

7 Technical specification

1 General Specifications

1.1 Genenral specifications

Size	
Monitor	
Without extension modules	312±5 mm (H) * 312±5 mm (W) * 158±5 mm (D)
With extension modules	312±5 mm (H) * 352±5 mm (W) * 178±5 mm (D)
Weight	
With extension module, recorder and CO_2	6 kg
Environment	
Operating temperature	Normal operation: +5 to +40°C (41 to 104°F) Charging batteries: +5 to +35°C (41 to 95°F)
Storage and transport temperature	-20 to +60°C (-4 to 140°F)
Operating humidity	20 to 90% noncondensing
Storage and transport humidity	20 to 90% noncondensing
Operating atmospheric pressure	700 to 1060 hPa (525 to 800 mmHg)
Storage and transport atmospheric pressure	700 to 1060 hPa (525 to 800 mmHg)
Electrical	
AC input voltage	100 to 240 V
AC input frequency	50/60 Hz
AC input power	150 VA
Power supply	Internal battery or AC power
Power cord type	cord connector IEC/EN 60320-1/C13
For USA, difference type of plugs should be used for connection to the alternate voltage 13 A 125 V or 6 A 250 V.	
Fuse	250 V, 2.5 Ah
Battery	Exchangeable lithium-ion, 2 pcs max.
Battery life	300 cycles minimum to 50% capacity
Battery information	model SM 201-6; 11.1 V, 3.52 Ah
Charging time	2 hours per battery pack

Operation time	Up to 4.5 hours
Recorder	
Power comsumption	Standby: ≤ 1.2 W Printing: ≤ 10 W
Recorder type	Thermal array
Resolution	Vertical 8 dots/mm (200 dots/inch) in non-waveform mode Horizontal 24 dots/mm (600 dots/inch) mimimum in waveform mode
Paper width	50 mm, printing width 48 mm
Waveforms	Selectable 1, 2, or 3 waveforms
Print speed	1, 6.25, 12.5, 25 mm/s

1.2 Defibrillator synchronization connector

Synchronization pulse (Pin 5)	
Pulse width:	10 ms positive pulse
Delay:	< 35 ms (R-wave peak to leading edge of pulse)
Amplitude:	CMOS compatible 3.5 V min. at 1 mA sourcing 0.5 V max. at 5 mA sinking
Output impedance:	50 Ω
Current limit:	10 mA

2 Parameters specifications

2.1 ECG specifications

Leads available	3-lead configuration: I, II, III 5-lead configuration: I, II, III, aVR, aVL, aVF and VA
QRS detection range	0.5 to 5mV
QRS detection width (Q to S)	40 to 120 ms
Defibrillation protection	5000 V, 360 J
Recovery time	<5 s
Input impedance	Common mode > 10 M Ω @ 50/60 Hz Differential > 2.5 M Ω from 0.67 to 40 Hz
Common mode rejection	90 dB minimum at 50 Hz
Tall T wave rejection	>1.4 mV
ECG leads off detection	Active patient electrode: <30 nA Reference electrode: <120 nA
Filter modes	
60 Hz	
Monitoring filter	0.5 to 40 Hz
ST filter	0.05 to 40 Hz
Dagnostic filter	0.05 to 150 Hz
50 Hz	
Monitoring filter	0.5 to 35 Hz
ST filter	0.05 to 35 Hz
Dagnostic filter	0.05 to 150 Hz
Heart rate	
Measurement range	30 to 300 bpm
Measurement accuracy	±5 % or ±5 bpm, whichever is greater
resolution	1 bpm
Heart rate response time (ANSI/AAMI EC13-2002 Section 4.1.2.1f)	
Step increase from 80 to 120 bpm	average 6.9 s (6.5 to 7.5 s)
Step decrease from 80 to 40 bpm	average 8.2 s, (7.6 to 10.0 s)

The heart rate calculation operates with irregular rhythms of ANSI/AAMI EC13-2002 Section 4.1.2.1e, the heart rate after a 20 second stabilization period is:	
Figure 3a	80 bpm
Figure 3b	59 bpm
Figure 3c	122 bpm
Figure 3d	117 bpm
Heart rate averaging computation (ANSI/AAMI EC13-2002 Section 4.1.2.1d): Average of 10 second median values	
The average time and time range ( ) to alarm (VFib or VTachy) for tachycardia waveform are as follows (ANSI/AAMI EC13-2002 Section 4.1.2.1g)	
Figure 4a halved amplitude:	9.9 s (8.4 to 11.5 s)
Figure 4a normal amplitude:	7.1 s (5.8 to 8.2 s)
Figure 4a doubled amplitude:	4.4 s (4.2 to 4.6 s)
Figure 4b halved amplitude:	7.0 s (6.1 to 7.5 s)
Figure 4b normal amplitude:	5.8 s (4.5 to 7.4 s)
Figure 4b doubled amplitude:	6.1 s (5.1 to 7.0 s)
ST	
ST numeric range	-9 to 9 mm (-0.9 to 0.9 mV)
ST numeric accuracy	±0.2 mm or ±10%, whichever is greater (within the range of -8 to 8 mm)
ST numeric resolution	0.1 mm
Pacemaker detection	
Input voltage range	2 to 700 mV
Input pulse width	0.5 to 2 ms
Input overshoot	Specified for both Method A and Method B required in ANSI/AAMI EC13-2002 Section 4.1.4.2
Pacer pulse rejection of fast ECG signals	2.0 V/s (according to the test defined in ANSI/AAMI EC13-2002 Section 4.1.4.3)

NOTE: Pacemaker detector may not operate correctly during the use of high-frequency (HF) surgical equipment. The disturbances of HF surgical equipment typically cause false positive pacer detection.

Direct cardiac application:

The display area reserved for the ECG measurement in the monitoring system screen may not be adequate for displaying the complete ECG amplitude when measuring ECG direct from the surface of the heart. Clipping of the signal can be reduced by adjusting the size of the signal on the screen (for example, from the default 1.0 to 0.2) in the ***ECG*** menu.

2.2 Impedance respiration specifications

Measurement range	4 to 120 resp/min
Measurement accuracy	±5% or ±5 resp/min, whichever is greater
Nomalized respiration sensing current	<5.0 µA
Impedance respiration carrier frequency	31.25 kHz

2.3 GE SpO_2 specifications

Measurement and display range	0 to 100%
Calibrated against functional oxygen saturation.	
Measurement accuracy	100 to 70% ±2 digits 69 to 0% unspecified
Display resolution	1 digit (1% of SpO_2)
Display averaging	5 to 20 seconds
Wavelength of SpO_2 probe LEDs:	Infrared LED 940 nm RedLED 660 nm
Maximum energy of SpO_2 probe LEDs:	Infrared LED 42 µJ/pulse Red LED 62 µJ/pulse
Artifact rejection	SpO_2 values ±3% and PR values ±5%, when trapping with a finger for 10s
Pulse rate	
Measurement and display range	30 to 250 bpm
Display resolution	1 bpm
Measurement accuracy	±5% or ±5 bpm, whichever is greater

2.4 Nellcor SpO_2 specifications

Measurement and display range	1 to 100%
Measurement accuracy	Adult 100 to 70% ±2 digits Neo 100 to 70% ±3 digits Low perfusion 100 to 70% ±2 digits
Display resolution	1% of SpO_2
Display averaging	2 to 7 seconds
Pulse rate	
Measurement and display range	20 to 250 bpm
Display resolution	1 bpm
Measurement accuracy	±3 digits
Sensor Light Source	
Wavelength	Infrared: 890 nm (nominal) Red: 660 nm (nominal)
Power Dissipation	Infrared: 22.5 mW (max) Red: 30 mW (max)

2.5 Masimo SpO_2 specifications

Measurement and display range	1 to 100%
Measurement accuracy	
Without motion	Adult/Pediatric 100 to 70% ±2 digits Neonate 100 to 70% ±3 digits
With motion	Adult/Ped/Neo 100 to 70% ±3 digits
Low perfusion	100 to 70% ±2 digits
	0~69% unspecified
Display resolution	1% of SpO_2
Display averaging	2 to 16 seconds
Pulse rate	
Measurement and display range	25 to 240 bpm
Display resolution	1 bpm
Measurement accuracy	Without motion ±3 bpm With motion ±5 bpm

Sensor Light Source	
Wavelength	Infrared: 905 nm (nominal) Red: 660 nm (nominal)
Power Dissipation	Infrared: 22.5 mW (max) Red: 27.5 mW (max)

2.6 NIBP

Measurement technique	Oscillometric with step deflation
Supported modes	Manual, automatic and stat
Measurement time	Adult/Pediatric inflate duration time less than 120 s Neonate cycle time less than 85 s
Measurement ranges	
Systolic	Adult/Pediatric: 30 to 290 mmHg Neonate: 30 to 140 mmHg
MAP	Adult/Pediatric: 20 to 260 mmHg Neonate: 20 to 125 mmHg
Diastolic	Adult/Pediatric: 10 to 220 mmHg Neonate: 10 to 110 mmHg
Accuracy	According to AAMI SP10-2002 4.4.5.2 B, accuracy of NIBP parameter was validated against the intra-arterial method [1].
Default initial inflation pressure	Adult/Pediatric: 135 ± 15 mmHg Neonate: 100 ± 15 mmHg
Over pressure allowed by independent safety controller	Adult/Pediatric: 300 to 330 mmHg Neonate: 150 to 165 mmHg
1. Blood pressure measurements determined with this device are equivalent to those obtained by an intra-arterial blood pressure measurement device, within the limits prescribed by the American National Standard, Manual, electronic, or automated sphygmomanometers	

2.7 Invasive blood pressure

Measurement range	-40 to 320 mmHg (-5.3 to 42.7 kPa)
Measurement accuracy	±5% or ±2 mmHg, whichever is greater
Frequency response	4 to 22 Hz
Transducer sensitivity	5 µV/V/mmHg
Pulse rate	
Range	30 to 250 bpm
Accuracy	±5% or ±5 bpm, whichever is greater
Display resolution	1 bpm
Zero adjustment range	± 150 mmHg

2.8 Temperature

Measurement units	° Fahrenheit (F) ° Celsius (C)
Measurement range	10 to 45°C (50 to 113°F)
Measurement accuracy	± 0.1°C without temperature sensor
Display resolution	± 0.1°C at 25 to 45 °C with reusable probes
Probe types supported	Use only GE Healthcare recommend temperature YSI probes.
Temperature self-check	At start-up and then every 10 minutes
Probe type time response	
Reusable skin temperature probe:	3 s
Reusable adult central temperature probe:	6 s
Reusable pediatric central temperature probe:	4 s
Disposable skin temperature probe:	3 to 6 s
Disposable central temperature probe, 12F:	5 to 8 s
Disposable central temperature probe, 9F:	5 to 8 s

2.9 Airway gases

Sampling rate	150±25 ml/min (sampling line 2 to 3 m, normal conditions)
Maximum sampling line length:	6 m
Sampling delay	2.1 s typical with a 3-m sampling line
Total system response time	2.4 seconds typical with a 3-m sampling line, including sampling delay and rise time
Warm-up time	1 minute for operation 30 minutes for full specification
Autozeroing interval	4, 15, 30 and 60 minutes after start-up, then every 60 minutes
NOTE: The drift of measurement accuracy will be cleared after autozeroing.	
Carbon dioxide (CO_2)	
Measurement range	0 to 20 vol%
Accuracy 0 to 15 vol% 15 to 20 vol%	 ± (0.2 vol% + 2% of reading) ± (0.7 vol% + 2% of reading)
Resolution	0.1%
Measurement rise time	< 300 ms with nominal flow
Valid for respiration rate < 40 breaths/min at I:E ratio of 1:1. (Relative error is typically 10% for respiration rate 80 breaths/min at I:E ratio of 1:1.) The accuracy is specified in simulated ventilation. With higher respiration rates and with varying ventilation methods the specifications may not be met.	
Respiration rate	
Breath detection	1% change in CO_2 level
Measurement range	4 to 80 breaths/min
Accuracy	±1 breaths/min in the range 4 to 20 breaths/min ±5% in the range 20 to 80 breaths/min

Resolution	1 breaths/min
Non-disturbing gases are those with a maximum effect on the CO_2 reading at 5.0 vol% < 0.2 vol%. The effect is valid for specific concentrations shown in parentheses of the non-disturbing gas:	Ethanol C_2H_5OH (<0.3%) Acetone (<0.1%) Methane CH_4(<0.2%) Nitrogen N_2 (0 to 100%) Water vapor (0 to 100%) Dichlorofluoromethane (<1%) Tetrafluoroethane (<1%)
Disturbing gases and their effect on the CO_2 reading at 5.0 vol% CO_2 are shown below. Errors listed reflect the effect of specific concentrations (shown in parentheses) of an individual disturbing gas and should be combined when estimating the effect of gas mixtures:	Halothane (4%) increases < 0.3 vol% Isoflurane(5%) increases < 0.4 vol% Enflurane(5%) increases < 0.4 vol% Desflurane(24%) increases < 1.2 vol% Sevoflurane(6%) increases < 0.4 vol% If O_2 compensation is not activated: O_2 (40 to 95%) decreases < 0.3 vol% If O_2 compensation is activated: O_2 (40 to 95%) error < 0.15 vol% If N_2O compensation is not activated: N_2O (40%) increases < 0.4 vol% If N_2O compensation is activated: N_2O (40 to 80%) error < 0.3 vol%

NOTE: CO_2 measurement is intended for patients weighing over 5 kg (11 lb).

8 E-MiniC Module

1 Introduction

This chapter provides information for the maintenance and service of the Single-width Airway Module, E-miniC. The Single-width Airway Module is a single-width plug-in module designed for use with the GE modular monitors.

The Single-width Airway Module provides airway and respiratory measurements.

Letter C in the module name stands for CO_2.

NOTE: E-miniC is intended for patients weighing over 5kg (11lb).

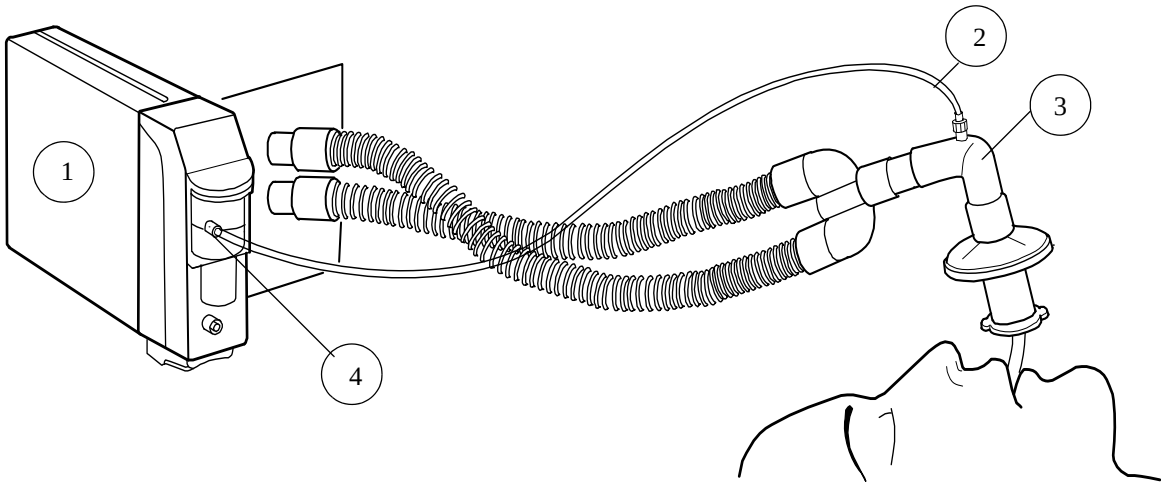


Figure 1 Airway gases setup with E-MiniC Module

1. Module for measuring airway gases
2. Anesthesia gas sampling line
3. Airway adapter with sampling line connector
4. Sampling line connector

Monitor software compatibility

The Single-width Airway Module, E-miniC, is designed for use with VSP or later versions respectively.

Equipment safety symbols

- When displayed on the E-miniC module, indicates that airway gases should be calibrated every six months in normal use and every two months in continuous use.

2 Specifications

2.1 General specifications

E-MINIC

Module size, W × D× H	37 × 209 × 112 mm, 1.5 × 8.2 × 4.4 in
Module weight	0.4 kg/0.9 lb.

2.1.1 Environmental specifications

Operating temperature	+10...+40 °C (+50 to 104 °F)
Storage temperature	-20...+60 °C (-4 to +140 °F)
Atmospheric pressure	666...1060 hPa / (67...106 kPa) (500...800 mmHg) (666...1060 mbar)
Humidity	10...95% non-condensing (in airway 0...100%, condensing)
Protection against electrical shock	Type BF

2.1.2 Functional alarms

Funtional alarms for

- Blocked sample line
- D-Fend replacement
- D-Fend check

2.2 CO_2 measurement

2.2.1 Typical performance

$EtCO_2$	End-tidal CO_2 concentration
$FiCO_2$	Inspired CO_2 concentration
Measurement range	0 to 20 vol% (0 to 20 kPa, 0 to 150 mmHg)
Accuracy	CO_2 concentration 0 to 15 vol% ±(0.2 vol% +2% of reading) CO_2 concentration 15 to 20 vol% ±(0.7 vol% +2% of reading)
Measurement rise time	< 300 ms with nominal flow

Adjustable low and high limits for $EtCO_2$ and $FiCO_2$.

2.2.2 Technical specifications

Airway humidity	0...100%, condensing
Sampling rate	150 ±25ml/min (sampling line 2 to 3 m, normal conditions)
Sampling delay	2.1 seconds typical with a 3-m sampling line
Total system response time	2.4 seconds typical with a 3-m sampling line, including sampling delay and rise time (typically 3.7 seconds with a 6-m sampling line).

Automatic compensation for barometric pressure, CO_2-NO_2 and CO_2-O_2 collision broadening effect compensation selectable from menu.

Warm-up time	1 min for operation with CO_2, 30 min for full specification
Zeroing interval	4, 15, 30 and 60 minutes after start-up, then every 60 minutes.

2.2.3 Normal conditions

Accuracy specifications apply in normal conditions (after 30 minutes warm-up period):

Ambient temperature	18...28 °C, within ±5°C of calibration
Ambient pressure	500...800mmHg, ±50mmHg of cal.
Ambient humidity	20...80% RH, ±20% RH of cal.

Automatic compensation for barometric pressure.

Non-disturbing gases are those with a maximum effect on the CO_2 reading <0.2 vol%. The effect is valid for specific concentrations shown in parentheses of the non-disturbing gas:

- Ethanol C_2H_5OH (<0.3%)
- Acetone (<0.1%)
- Methane CH_4 (0.2%)
- Nitrogen N_2
- Water vapor
- Dichlorofluromethane (<1%)
- Tetrafluoroethane (<1%)

Disturbing gases and their effect on the CO_2 reading at 5.0 vol% CO_2 are shown below. Errors listed reflect the effect of specific concentrations (shown in parentheses) of an individual disturbing gas and should be combined when estimating the effect of gas mixtures:

- Halotane (4%) increases < 0.3 vol%
- Isoflurane (5%) increases < 0.4 vol%
- Enflurane (5%) increases < 0.4 vol%
- Desflurane (24%) increases < 1.2 vol%
- Sevoflurane (6%) increases < 0.4 vol%
- Helium (50%) decreases < 0.3 vol%
- If O_2 compensation is not activated: O_2 (40 ... 95%) decreases < 0.3 vol%
- If O_2 compensation is activated: O_2 (40 ... 95%) error < 0.15 vol%
- If N_2O compensation is not activated: N_2O (40%) increases < 0.4 vol%
- N_2O (40 to 80%) increases < 0.8 vol%
- If N_2O compensation is activated: N_2O (40 to 80%) error < 0.3 vol%

2.2.4 Conditions exceeding normal

Accuracy specifications under the following conditions ✍❷✍:

✍ Ambient temperature	10...40 °C, within ±5 °C of calibration
Ambient pressure	500...800 mmHg, ±50 mmHg of calibration
Ambient humidity	10...98% RH, ±20% RH of calibration

❷ During warm-up 1 to 10 minutes, under normal conditions

✍ During warm-up 10 to 30 minutes, under normal conditions

	Accuracy under different conditions (see above)	
	Conditions ✍ and ✍	Condition ❷
CO_2 (0 ... 15 vol%)	±(0.3 vol% + 4% of reading) (at 5 vol% error ±0.5 vol%)	±(0.4 vol% + 7% of reading) (at 5 vol% error ±0.75 vol%)
CO_2 (15 ... 20 vol%)	±(0.8 vol% + 4% of reading) (at 5 vol% error ±0.5 vol%)	±(0.9 vol% + 7% of reading) (at 5 vol% error ±0.75 vol%)

2.3 Respiration Rate (RR)

Measurement range	4 to 80 breaths /min
Breath detection	1% change in CO_2 level
Accuracy	±1/min in the range 4 to 20 l/min
	±5% in the range 20 to 80 l/min
Resolution	1/min

Adjustable low and high limits for respiration rate; alarm for apnea.

3 Functional description

3.1 Measurement principle

3.1.1 CO_2 measurement

E-MiniC is a side stream gas analyzer, measuring real time concentrations of CO_2. It is a non dispersive infrared analyzer that measures absorption of the gas sample using an optical narrow band filter.

The infrared radiation detector is thermopile.

Concentration of CO_2 is calculated from absorption measured at 4.2 to 4.3 μm.

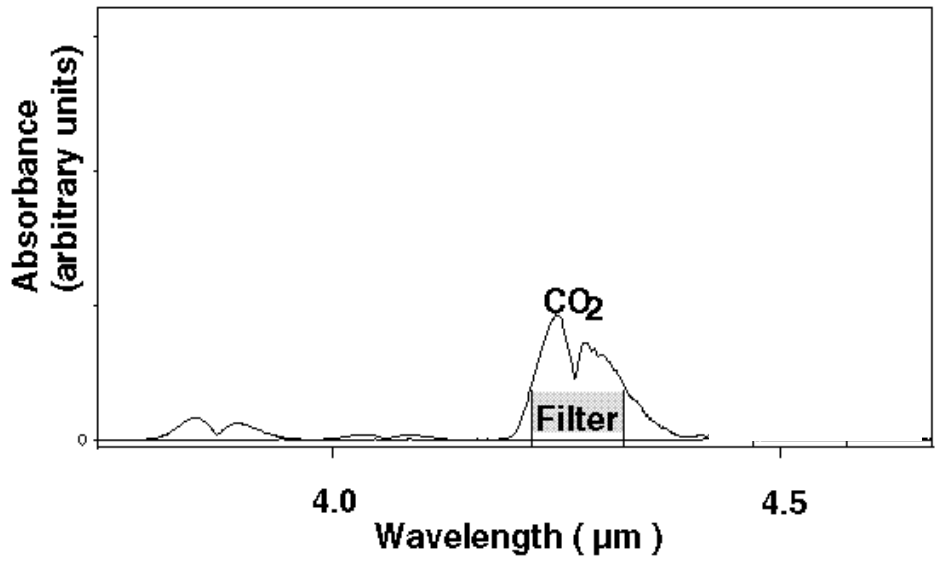


Figure 2 Absorbance of CO_2

3.2 Main components

- Gas sampling system
- MiniC measuring unit
- CPU board

3.2.1 Gas sampling system

The sampling system draws a gas sample to the analyzer at a fixed rate.

The gas sampling system samples the measured air to the module, and removes water and impurities from it. A sampling line is connected to the water trap. The pump draws gas through the sampling line to the gas measuring unit. After the measurement, the gas is exhausted from the sample gas out connector.

The sample flow is nominally 150 ml/min.

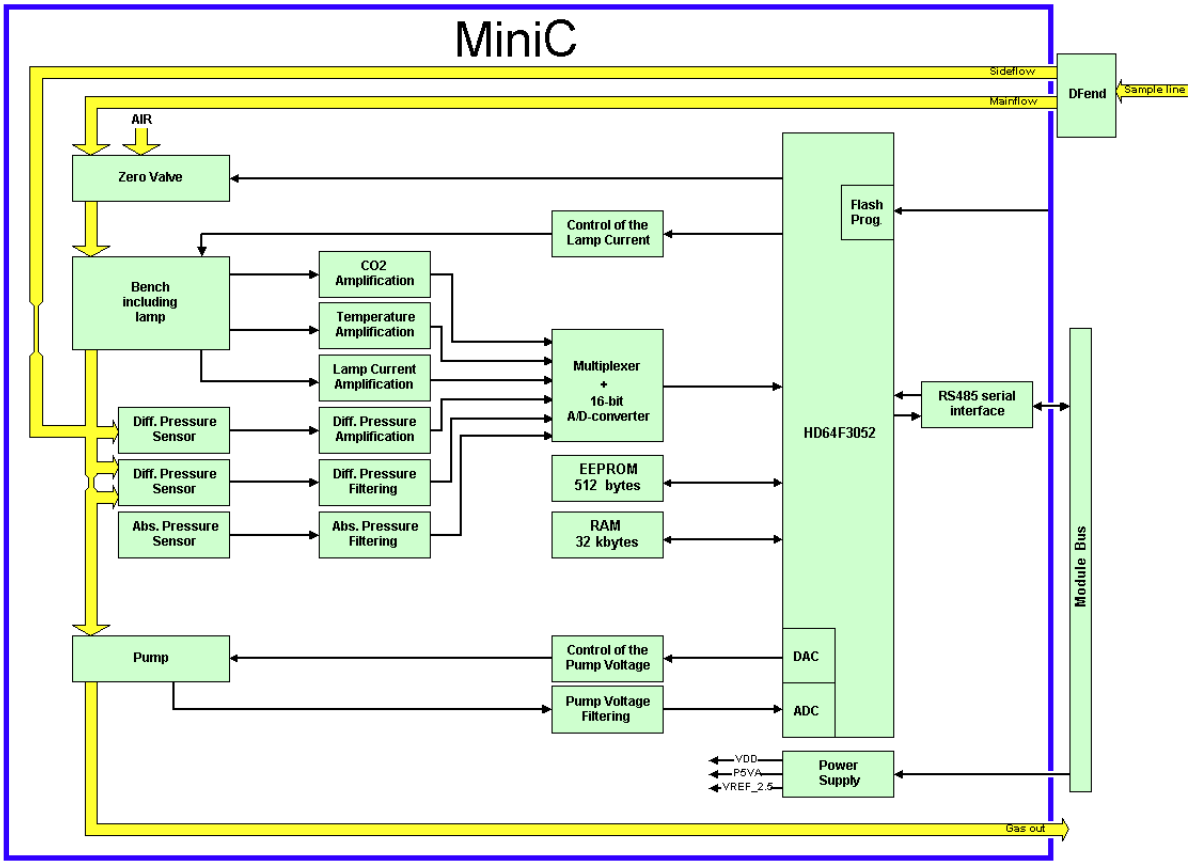


Figure 3 MiniC block diagram

Mini D-fend™

The sample is drawn through the sampling line. The gas then enters the module through the water trap, where it is divided into two flows, a main flow and a side flow. The main flow goes into the analyzer. This flow is separated from the patient side by a hydrophobic filter. The side flow creates a slight subatmospheric pressure within the Mini D-fend water trap which causes fluid removed by the hydrophobic filter to collect in the bottle.

Zero valve

The main flow passes through a magnetic valve before proceeding to the analyzer. This valve is activated to establish the zero point for the MiniC measuring unit. When the valve is activated, room air is drawn through a filter into the internal system and the gas sensor.

Nafion™ tube [1)]

A Nafion tube is used between the water trap and the zero valve to balance the sample gas humidity with that of ambient air. The tube prevents errors caused by the effect of water vapor on gas partial pressure when humid gases are measured after calibration with dry gases.

Gas analyzers

After the zero valve and Nafion tube, the gas passes through the miniC measuring unit.

Sample flow differential pressure transducer

The sample flow differential pressure transducer measures pressure drop across a restrictor and calculates the sample flow from the pressure difference.

Working pressure transducer

The working pressure transducer measures differential pressure between the tubing and ambient air near the miniC measuring unit.

Atmospheric pressure transducer

The atmospheric pressure transducer measures real-time atmospheric pressure. The following messages are based on the obtained pressure values: 'sample line blocked', 'check D-fend', 'replace D-fend' and 'check sample gas outlet'.

Sampling pump and damping chamber

The gas sampling pump is a membrane pump run by a DC-motor. Sample flow is measured with a differential pressure transducer across a known restriction. The motor is automatically controlled to maintain a constant flow even when the D-fend water trap ages and starts to get occluded. It also enables the use of sample tubes with varying lengths and diameters.

NOTE: In no occasion is the flow reversed towards the patient.

1. [1)] Nafion is a trademark of Perma Pure Inc.

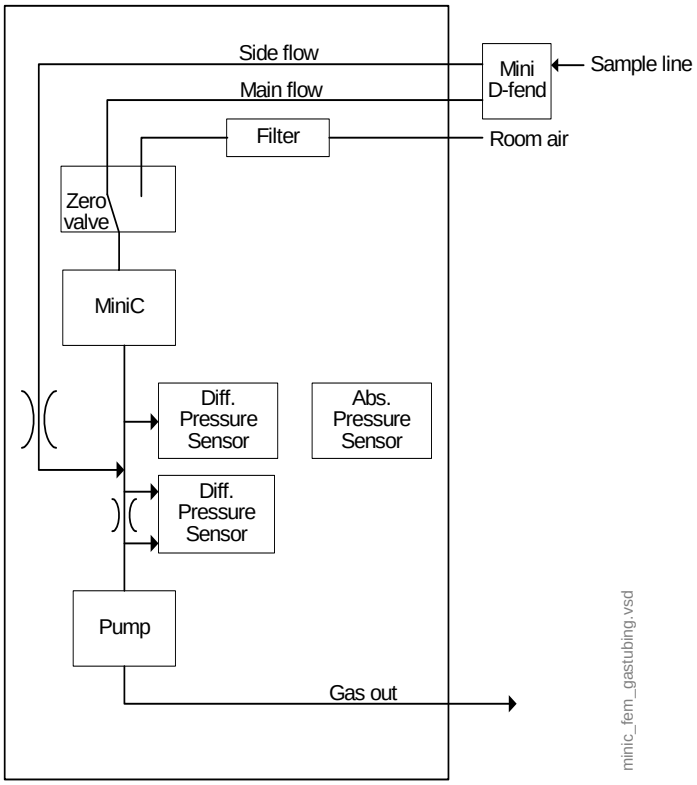


Figure 4 Gas tubing layout

3.2.2 MiniC sensor

The miniC sensor is a non-dispersive infrared analyzer measuring absorption of the gas sample at 4.2 to 4.3 μm infrared wavelength, which is selected using an optical narrow band filter. The IR lamp is a filament surrounded by thermal isolation. There is a hole in the isolation, passing the radiation to a conical measuring chamber with 3 mm length. From the sample chamber, the radiation goes into a thermopile detector with an optical filter in front of it.

The temperature sensor measures the miniC measuring unit's temperature and it is used for temperature compensation.

The miniC sensor is connected to the CPU board and they can't be replaced separately.

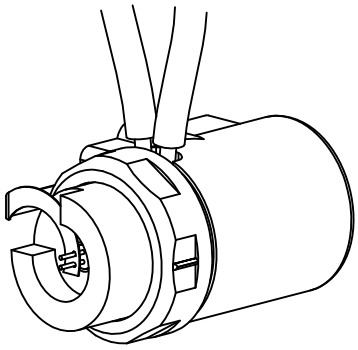


Figure 5 MiniC sensor

3.2.3 CPU board

The CPU board contains a processor, memories and all the analog signal processing needed. A MiniC measuring unit is attached to the board with a flexible PCB. Also supply voltage and an RS485 serial channel are connected to the CPU board using another flexible PCB.

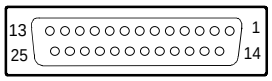
Analog signals (CO_2, temperature, absolute and differential pressures and lamp current signals) are fed to the 16-bit A/D converter. The processor controls the A/D converter and calculates the CO_2 percentage and respiration rate from this data.

The processor controls sample flow by adjusting the pump voltage based on the differential pressure signal. The processor also controls the current of the IR source and keeps it constant.

Calibration data is stored on the EEPROM.

3.3 Connectors and signals

Table 1 Module bus connector pin description

Module bus connector	Pin No.	I/O	Signal
	1	I	RESET RS485
	2	I	-15 VDC (not used)
	3	I	+15 VDIRTY
	4	I	+15VDC (not used)
	5	I/O	-DATA RS485
	6	I/O	DATA RS485
	7		Ground and Shield
	8	I	-RESET RS485
	9		n/c
	10		n/c
	11		n/c
	12		n/c
	13		Ground and Shield
	14	I	+24/+32 VDIRTY depends on power supply (not used)
	15	I	Ground DIRTY
	16		n/c
	17		n/c
	18		n/c
	19		n/c
	20	I	GASFR (not used)
	21	I	CTSD (not used)
	22	I	TXDD (not used)
	23	O	RXDD (not used)
	24	I	+5 VDC (not used)
	25	I	+5 VDC DIRTY (not used)

4 Maintenance and checkout

To help ensure the equipment remains in proper operational and functional order, adhere to a good maintenance schedule.

Corrective maintenance

Service personnel shall perform the following checkout procedure after any corrective maintenance, before taking the module back into clinical use:

Performed service activity	**Required checkout procedure**	
	Visual inspections	**Functional check**
Front cover replaced	All steps	Not applicable
Mini D-fend O-rings	All steps	Check "Leak test" and "Check the flow rates"
Module casing opened either for troubleshooting purpose or for replacing any of the internal parts.	All steps	All steps

Planned maintenance

Service personnel shall perform the following checkout procedure completely every 12 months after installation:

1. "Replacement of planned maintenance parts"
2. "Visual inspections"
3. "Functional checkout"

The instructions include a check form ("APPENDIX E") which should be filled in when performing the procedures.

The symbol in the instructions means that the check form should be signed after performing the procedure.

Recommended tools

Tool	Order No.	Notes
Screwdriver		Pozi-drive, Torx T10
Ambient pressure manometer		Amb. Press. can be checked from local meteorological station
Flowmeter		TSI model 4140 recommended
Flow cassette 50/1.1	873812	
Calibration gas and the regulator	755580 (gas) 755534	Contains 5 CO_2 and air
Gas Interface Cable	884299	

4.1 Replacement of planned maintenance parts

4.1.1 Required parts

Replace the following parts that wear in use at the recommended interval.

Part Number	Description	Pieces	Replacement interval
733382-HEL	Nafion Tube	1	Once a year
656565	Mini D-fend™ O-ring	2	Once a year
M1011471	Zero valve air filter	1	Once every 3 years

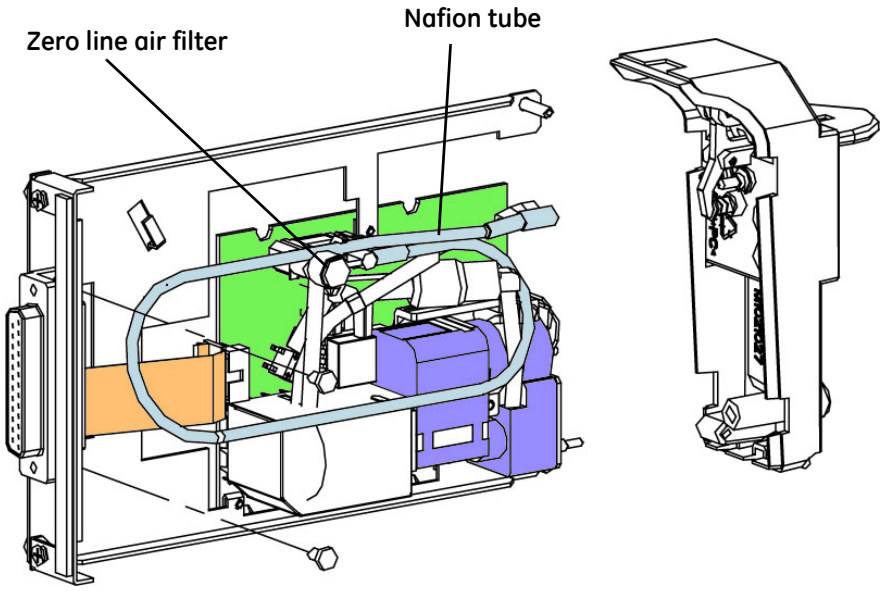
It is also recommended to replace the Mini D-fend water trap and the gas sampling line as part of the planned maintenance procedure.

NOTE: See the supplies and accessories document delivered with the manual for compatible accessories.

4.1.2 Replacement procedure

Replace the specified planned maintenance parts according to the following procedure. Refer to "5. E-MiniC module disassembly and reassembly" for more information.

1. Replace the zero valve air filter once every 3 years.
   - Use a small flat blade screwdriver to pull the old zero line air filter.
   - Attach a new zero line air filter into place.



2. Replace the special tube (Nafion) and check the condition of the internal tubing.
   - Replace the 300 mm nafion tube in the sample gas line between the Mini D-fend water trap and the zero valve unit.

- Check that the tubing inside the module is not contaminated. Any contamination inside the tubing may indicate that the valve or sensor is contaminated too. This can increase a risk of faulty operation in valve or sensor. The gas sensor is not possible to clean in the field. Therefore, replace the whole miniC assembly with a new one.

NOTE: The nafion tube do not include the silicon fittings they connect to. Use the original silicon fittings unless they are not damaged or leaking.

3. Replace the Mini D-fend O-rings:
   - Detach the Mini D-fend.
   - Detach the old rubber O-rings that are around the metal Mini D-fend connectors e.g. using a small flat blade screwdriver. Pay special attention not to scratch the metal Mini D-fend connectors and thus causing leaking.
   - Set the new rubber O-rings into place and attach a new Mini D-fend.

4.2 Visual inspections

Detach the module from the module slot and check that:

- the front cover panel is intact
- all connectors are intact and attached properly.
- the module box and latch are intact
- the metal D-fend connectors and the D-fend O-rings are clean and intact
- the module and the applied parts are clean

The cleaning precautions, cleaning requirements, cleaning procedures, and recommended cleaning solutions for the monitor are described in the "PROCARE Monitor B40/B20 User's Guide". For details about cleaning, disinfecting and sterilizing the accessories, see the instructions for use in the accessory package.

4.3 Functional checkout

NOTE: Before the testing, check the CO2 unit: **Airway Gas** > ***CO2 Setup*** > ***Unit***, make sure the unit is ***mmHg***.

1. Check Mini D-Fend

   Detach the Mini D-fend. Check the condition of the rubber O-rings on the metal Mini D-fend connectors, located in the module front cover.

   If necessary, detach the connectors by first disconnecting the tubes, then removing the locking rings from the back of the front cover.

   Replace the Mini D-fend and sampling line with new ones.

NOTE: Use only GE Datex-Ohmeda sampling lines in order to ensure proper functioning.

Turn on the monitor.

Configure the monitor screen so that the CO_2 curve is shown, for example as follows:

Monitor Setup - ***Screen Setup - Waveform fields - Field 6 - CO2***

Digit Fields

Lower Field 1 - Gases

If one of the values is increasing faster, it indicates a failure in module bus communication.

2. Flow measurement offset

   Enter the service menu ***Gases***:

   Gas Unit - Gases

   Check that the flow measurement offset, i.e. the shown sample Zero value is within ±10 ml/min.

3. Ambient pressure

   Check that the shown Ambient value corresponds with the current ambient pressure (±20 mmHg).

4. Zero valve check

   Feed calibration gas and check that the gas readings in the service menu correspond with the values on the gas bottle sticker. Keep feeding gas, then activate the zero valve from the menu. The CO_2 reading should drop back to near 0%.

5. Nafion tube

   Replace the Nafion tube, if necessary.

NOTE: The Nafion tube should be replaced annually.

6. Leak test

   Perform the sampling system leak test.

   Connect a flow cassette with high flow resistance value (50/1.1) to the end of the sampling line and start following the Amb-Work value in the service menu. When the value exceeds 130 mmHg, connect the other port of the flow cassette to the sample gas out connector and switch off the pump.

   Wait until the pressure inside the sampling system is stabilized, then observe the shown Amb-Work value. The value, i.e. the pressure inside the sampling system should not drop more than 6 mmHg in 20 seconds.

   If the pressure drops more, first check the connections and repeat the test.

7. Check the flow rates

   Wait until the Sample Flow value returns close to 150 ml/min.

   Connect a flow meter to the 3 meter sampling line and check that the flow (the flow meter reading) is within the following range:

   Sampling flow (ml/min) 135...165

   If necessary, readjust the sampling flow:

   Select ***Sample gain adj*** from the menu.

   To increase the sampling flow, turn the ComWheel counterclockwise. To decrease the flow, turn the ComWheel clockwise.

   A change of 0.050 in the Gain value changes the flow approximately 7.5 ml/min.

   After you have changed the gain, wait until the Sample Flow value on the screen returns near to the original, then check the flow meter reading again.

8. Working pressure

   Check that the Amb-Work value in the service menu is within the following range:

   Amb-Work (mmHg) 20...50

9. Gas calibration

   Airway Gas - ***Gas Calibration***

NOTE: The calibration should not be performed before 30 minutes warm-up time.
Use calibration gas 755580 (5% CO_2, about 20% O_2) for calibrating the E-miniC.

10. Occlusion detection

    Block the tip of the sampling line with your finger and check that the message 'Sample line blocked' appears on the monitor screen within 60 seconds.

11. Check D-fend

    Detach the mini D-fend and check that the message 'Check D-fend' appears on the monitor screen within 30 seconds.

12. Apnea detection

    Reattach the mini D-fend. Simulate at least 5 breaths by feeding calibration gas into the sampling line. Check that the shown gas information is correct.

Check that the monitor shows the message 'Apnea' within 30 seconds after you have stopped feeding the gas.

13. Final cleaning

    Turn off the monitor, disconnect and clean the module.

- Fill in all necessary documents.

5 E-MiniC module disassembly and reassembly

5.0.1 Before disassembly

NOTE: Wear a grounded, antistatic wristband when handling PC boards. Electrostatic discharge may damage components on the board.

NOTE: Handle all PC boards by their edges.

5.0.2 Tools needed

- torx screwdrivers; T10
- flat blade screwdriver
- pincers
- antistatic wristband

5.1 To disassemble the module

To disassemble the airway module (see the exploded view of the module in the "E-Modules Spare parts" slot):

1. Remove the two screws (T10) from the back of the module.
2. While pressing the release latch, pull the module box slowly backwards and remove it from the main body.

To remove the Module Front Cover from the module, release the snaps that hold the front cover to the front chassis.

CAUTION When reassembling the module, make sure that the tubes and cables are not pinched between the boards and the cover.

5.1.1 Pump unit

1. Remove the module cover.
2. Remove the mask.
3. Unplug the hose of the pump.
4. Disconnect the pump's cable from the CPU board.
5. Remove the three screws that connect the pump unit to the board.

To reassemble the module, reverse the order of the dissassembly steps.

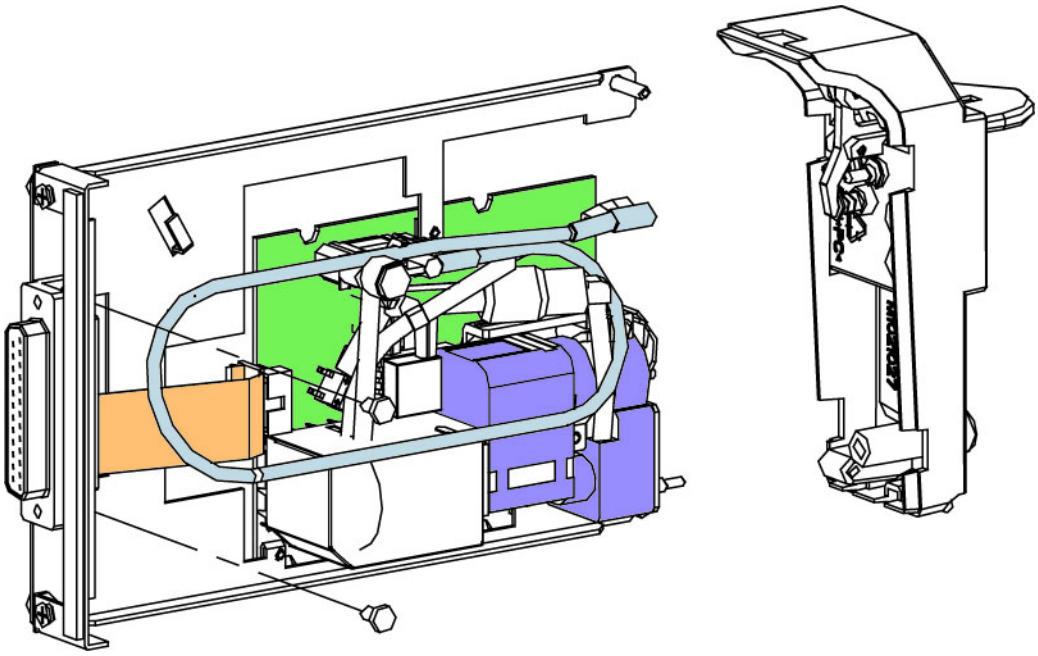


Figure 6 Uncovered E-miniC module

5.1.2 MiniCO$_2$ assy

1. Remove the module cover.
2. Unplug two tubes from the back of the mask.
3. Remove the mask.
4. Detach the miniCO$_2$ assy from the frame plate by removing the three screws.
5. Disconnect the FM board from the miniCO$_2$ assy.

To reassemble the module, reverse the order of the dissassembly steps.

5.1.3 Instructions after replacing MiniCO$_2$ assy

After replacing the MiniCO$_2$ assy:

- perform the sampling system leak test
- perform the occlusion test
- perform the gas calibration

5.2 Adjustments and calibrations

5.2.1 Calibrating

NOTE: Ensure that the calibration gas and regulator are functioning properly before calibration. Perform the annual maintenance of the regulator as required.

The airway module should be calibrated once every six months or whenever there are indications of errors in the gas readings.

Calibrate the gas measurement with the Datex-Ohmeda calibration gas. Do not use any other calibration gases.

– Use the regulator 755534.

When you calibrate the E-miniC module, use gas 755580 only and set the O_2 concentration to 20%.

Use only recommended calibration gases to guarantee a successful calibration.

During gas calibration, % units are always used for CO_2 regardless of selected measuring units.

NOTE: Ensure that the calibration gas and regulator are functioning properly before calibration. Perform the annual maintenance on the regulator as required.

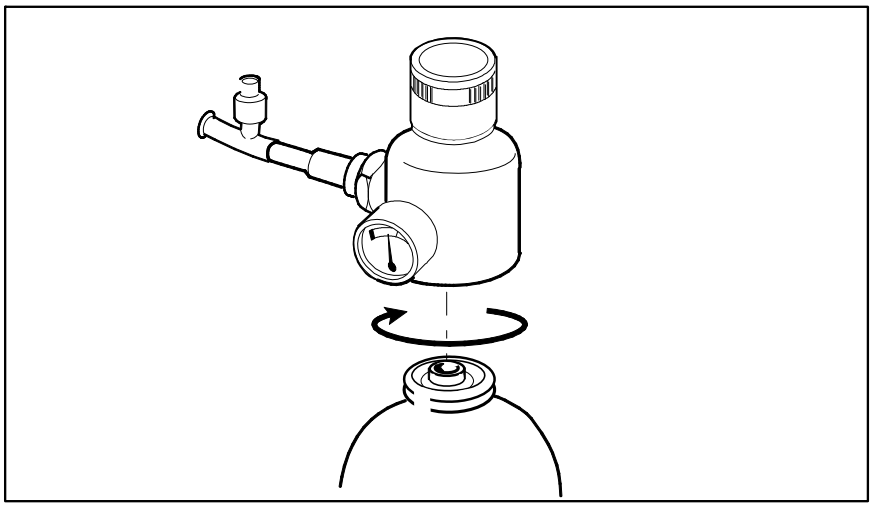


Figure 7 Attaching regulator to the calibration can

1. Attach the regulator to the gas container.
2. Attach a new sampling line to the water trap. Connect the loose end of the sampling line to the regulator on the gas container.

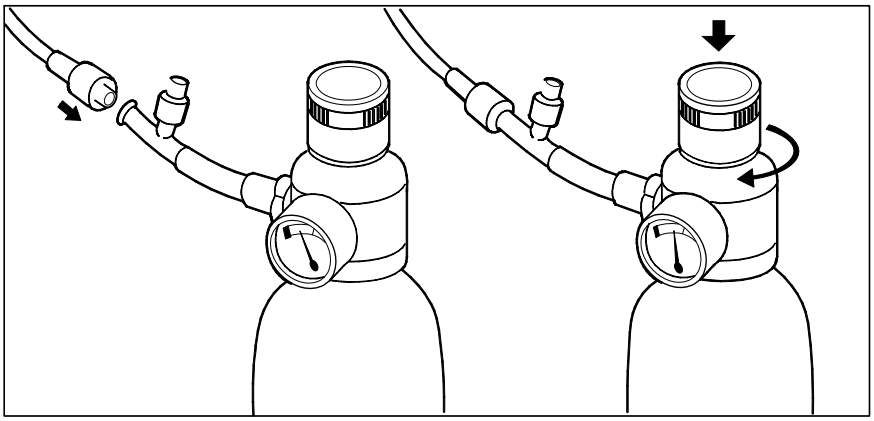


Figure 8 Connecting sampling line to the gas valve and feeding gas

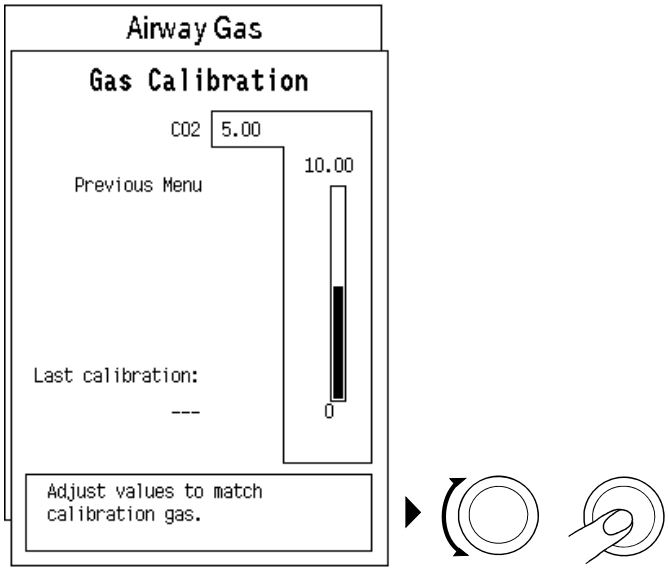
3. Turn on the power. For maximum accuracy, let the monitor warm up for 30 minutes. The menu item ***Gas calibration*** remains gray as long as the message 'Calibrating gas sensor' is displayed.
4. Press the **Airway Gas** key and select ***Gas calibration***.
5. Wait until the 'Zero ok' and then the 'Feed gas' messages appear after each gas on the screen.
6. Open the regulator and feed calibration gas until the message 'Adjust' appears, then close the valve. If you use an older brass regulator, the feeding pressure should be adjusted between 5 and 7 psi.
7. Check that the displayed gas value matches the value on the calibration gas container.

NOTE: When calibrating the E-miniC module, set the O_2 level according to the gas, for example with 755580, set the FiO_2 level in the CO2 setup menu to 21-40% and the ***AIRWAY GAS - CO2 SETUP*** O_2 level to 20%. Adjust the O_2 percentage according to the calibration gas (for 755580 the right O2 value is 20%).

NOTE: If an error occurs during calibration or if no gas is fed, the highlighting goes automatically over the item ***Recalibrate*** and the text 'Calibr. error' appears. Push the Trim knob to perform a new calibration.

If adjustments are required:

- Turn the Trim knob to highlight the first gas to be adjusted and then push the Trim knob.
- Turn the Trim knob until the displayed value matches the desired value in the gas bottle and push it again.



If the message 'Zero error' is displayed, press the **Normal Screen** key and repeat the calibration procedure.

The time of the last calibration is shown at the bottom of the menu page.

5.2.2 Gas sampling system adjustment

For flow rate measurements, a flow meter with a low flow resistance and the capability to measure low flow rates is required. A sampling line of normal length has to be connected to the monitor as it has a considerable effect on the flow.

5.2.3 Flow rate measurement

If any flow rates are not correct, first replace the Mini D-Fend water trap, then recheck the flows.

The sampling flow rate is measured by a flow meter at the sampling line. The flow rate should be between 135 and 165 ml/min. The flow rate is adjusted in the ***Gases*** service menu with ***Sample gain adj***.

5.2.4 Flow rate adjustment

NOTE: Before adjusting the sampling flow, make sure there is no leakage in the sampling system.

Refer to 5.2.5. Gas calibration.

Wait until the Sample Flow value is back to near 150 ml/min.

Connect a flow meter to the 3 meter sampling line and check that the flow (the flow meter reading) is within the following range:

Sampling flow (ml/min) 135...165

If necessary, readjust the sampling flow:

Select ***Sample gain adj*** from the menu.

To increase the sampling flow, turn the Trim knob counterclockwise.

To decrease the flow, turn the Trim knob clockwise.

A change of 0.050 in the Gain value changes the flow approximately 7.5 ml/min.

After you have changed the gain, wait until the Sample Flow value on the screen returns near to the original, then check the flow meter reading again.

5.2.5 Gas calibration

Gas calibration is performed in the ***Airway Gas*** menu.

Calibration gas regulator flow check

Interval: every 12 months

Regulator flow specification:

REF 755533 & 755534: 260 – 410 ml/min at 1-10 bar cylinder pressure
REF 755530: 260 – 410ml/min at 5-7psi cylinder pressure

Tools needed: calibration gas can, regulator, piece of silicon hose and flow meter. Datex-Ohmeda recommends use of TSI 4140 Flow Meter.

Insert the calibration gas regulator on the gas cylinder. Connect a silicon hose between the regulator and the flow meter. Block the regulator overflow port and open the regulator. Check the flow rate from the flow meter and verify that the flow is within the specification.

6 Troubleshooting

6.1 Troubleshooting chart for CO_2 measurement

Problem	Cause/What to do
No response to breathing	Sampling line or water trap blocked or loose, or improperly attached. Water trap container full. See the gas sampling system troubleshooting.
'SENSOR INOP.' message	The temperature is too low or high, check the temperature in the service menu. Supply voltage is too low or high, IR source current or voltage is too low or high, check current in the service menu. Pump is not working properly, check sample flow and pump voltage in the service menu. Ambient pressure too low or high, check the ambient pressure in the service menu. Zero valve not working properly, check the functionality by switching zero valve on and off in the service menu.
'ZEROING ERROR' message	Gas zeroing failed. Condensation or residual gases are affecting the zero measurement. Allow the module to run drawing room air for half an hour and calibrate again.
'CHECK D-FEND' message	Amb – Work pressure difference too small. Probably water trap or the sampling line is not attached properly. Gas zero valve failure. Pump failure or gas outlet blockage.
'REPLACE D-FEND' message	Amb – Work pressure difference too big. Indicates residue build-up on the water trap membrane. This decreases air flow. Replace the D-fend.
'SAMPLE LINE BLOCKED' message	Amb – Work pressure difference too big. Sampling line or water trap is occluded. Water trap container is full. If occlusion persists, check internal tubing for blockages.
No response to any gas	Check Sample Gas Out. Amb - Work pressure low, flow too small and pump voltage too high. Sampling line, water trap, or internal tubing is blocked or loose, or improperly attached. Gas out connector or tubing is blocked. Zero valve malfunction. Pump failure or pump is worn. Supply voltage missing. Serial communication error.
Sudden increase in gas display	Water trap malfunction. Check all internal tubing and the interior of the water trap for occlusions or leaks. Replace water trap. Check flow rates.
Abnormally high (or abnormally low) response to CO_2 or sudden occlusion warning	Pressure transducer failure. Check the Ambient and Amb – Work pressures in ***Gases*** service menu.
Strong drift in all gases	Leak in sampling line or internal tubing (especially in conjunction with too low readings).

6.1.1 CO_2 measurement

Problem	Cause	What to do
Action too low $ETCO_2$ value	• sudden decrease in circulation • pulmonary embolism • hyperventilation • very large dead-space • large shunting • leak in sampling system • calibration error • high by-pass flow from ventilator	• check all connections • check calibration
too high $ETCO_2$	• hypoventilation • increased metabolism • D-fend contaminated • calibration error	• change D-fend • check calibration
waveform clipped	• incorrect scaling	• change scale
no response to breathing	• apnea • (disconnection) • sampling line or water trap loose or blocked (air leak)	• check all connections
	• sample gas outlet blocked	• check that outlet is open
$ETCO_2$ over scale >20% Shown until 32%, specified range 0...20%	• abnormally high $ETCO_2$ (permissive hypercapnia) • CO_2 sensor contaminated • D-fend malfunction	• let the module run without a sampling line until the CO_2 sensor has dried out • change D-fend
$ETCO_2$>$PaCO_2$	• unit is mmHg or kPa and $ETCO_2$ is close to arterial PCO_2 • "dry gas" as default	• change to "wet gas" by using install/service menu

6.2 Gas sampling system troubleshooting

The faults which can occur in the sampling system are: leaks or blockages in the tubing, failure of the sampling pump or the magnetic valves, or diminishing of the flow rates because of dirt accumulating in the internal tubing.

The following checks should help in localizing the fault. Whenever suspecting the sampling system and always after having done any work on the sampling system, check and if necessary adjust the flow rate.

CAUTION The special internal sample tube is mechanically fragile. Sharp bends will cause leaks.

NOTE: D-fend water trap should be replaced, when the 'REPLACE D-FEND' message appears during the monitor startup.

NOTE: If any liquid has entered the miniC measuring unit due to water trap filter failure, leave the module running without a sampling line for several hours and check the functions after it has dried out.

6.2.1 Sampling system leak test

1. Connect a flow cassette with a high flow resistance value (50/1.1) to the end of the sampling line and start following the 'Amb-Work' value in the service menu. When the value exceeds 130 mmHg, connect the other port of the flow cassette to the sample gas out connector and switch off the pump.
2. Wait until the pressure inside the sampling system is stabilized, then observe the shown Amb-Work value. The value, i.e. the pressure inside the sampling system, should not drop more than 6 mmHg in 20 seconds.
3. If the pressure drops more, first ensure the connections you have made and repeat the test.

6.3 MiniC unit troubleshooting

CAUTION The miniC measuring sensor can only be repaired and calibrated at the factory. In case of failure, the complete miniC unit should be sent to GE Healthcare for factory exchange.

6.4 Error messages

Message	**Explanation**
Occlusion or Sample Line Blocked	The sample tube inside or outside the monitor is blocked or water trap is occluded. If occlusion persists, measured gas values disappear.
Continuous occlusion. Check sample line and D-fend.	Occlusion over 40 seconds.
Check D-fend	- The water trap is not connected - There is a leak in the sampling line inside the module. If air leak persists, measured gas values disappear. Check sample gas out.
(Air leak detected.) Check water trap and sample gas out-flow. Press normal screen to continue.	Air leak over 40 seconds.
Replace D-fend (replace water trap)	Indicates residue build-up on the water trap membrane. This decreases air flow.
Gas calibration is not available during first 5 minutes/during occlusion/during air leak	Entering calibration is not allowed during 5 minutes after power up and during occlusion or air leak.

Message	**Explanation**
Gas out blocked	- Gas out connector on the front panel, or the exhaust line connected to it, is blocked. - If the sample gas is returned to the patient circuit, the filter in the return kit may be occluded. - Make sure the sample gas outlet is connected to an open scavenging system only where gas is removed in room pressure.
Recalibration	Time out, fluctuating gases, gain adjusted “over”.
Zero error	Unsuccessful zeroing.
Unstable, Calibr error	Unsuccessful calibration.
Menu messages during calibration:	
Zero error	Unsuccessful zeroing.
Adjust	Calibration gas accepted and monitor is ready for adjusting the gas values to match the calibration gas concentration.
Unstable	Unsuccessful calibration.

APPENDIX A: Software download instruction

1.1 Overview

This document describes the procedure to install software to a PROCARE Monitor B40/B20 patient monitor.

The software installation process consists of 2 main phases:

1) Software Transfer. Software transfer takes place using the GE Healthcare Software Transfer Utility that runs on a service PC. This application allows you to transfer new software from a Software CD to the patient monitor(s) through the Network or a crossover cable. The transferred new software will remain in an inactive state until the user purposely activates it.

2) Software Activation. Software activation is enabled only when a patient monitor is in a discharged state. You can perform it only for one patient monitor at a time.

1.2 Contents of the upgrade kit

The Software Download tool CD consists of the following:

- B40/B20 Main software (vsp, b40.xml, vspversion)
- B40/B20 Root file system (rootfs.img)
- B40/B20 Language files (S5FLASH0.BIN, S5FLASH1.BIN, S5FLASH2.BIN)
- B40/B20 Service download tool (GE Healthcare Software Transfer Utility)
- B40/B20 Software Installation Instruction

1.3 Related documents

Refer to the "B40/B20 Technical Reference Manual" for further information related to safety precautions and network configuration.

1.4 Connection methods

There are 2 different ways to connect a service PC to a patient monitor. Select a method that is applicable to network infrastructure you have.

NOTE: Software transfer occurs only in the case that the download mode is enabled and cannot be used to monitoring of a patient. Software activation is a separate phase and it is enabled only when the patient monitor is in a discharged state.

NOTE: When doing software transfer, please remove the multi I/O from the monitor if have.

a. Network method

In this method, a service PC is connected to the patient monitor via Network.

This connection method allows you to transfer software to several patient monitors at a time.

b. Ethernet crossover cable method

In this method, a service PC is connected to the patient monitor's Ethernet port with a crossover cable

This method allows you to transfer software only to one patient monitor at a time.

1.5 Required equipment

Connection method to be used	Required equipment
Network	• Service PC running Microsoft® Windows® NT™, 2000™ or XP™ withan Ethernet network card • Software CD • Ethernet cable
Ethernet crossover cable	• Service PC running Microsoft® Windows® NT™, 2000™ or XP™ withan Ethernet network card • Software CD • Ethernet crossover cable

1.6 Workflow

The following sections describe the sequential workflow for the software installation:

Sections 7 through 9 describe how to prepare the patient monitor(s) and the service PC for the software installation.

Sections 10 through 12 describe the software transfer process using the GE Healthcare Software Transfer Utility.

Sections 13 and 14 describe the software activation process and the functional check procedure after activating the new software.

1.7 Prepare the connections

Connect a service PC to network or directly to the patient monitor. Follow the appropriate procedure below.

Refer to section 5 Connection methods for details.

Connection method to be used	Procedure
Network	• onnect a service PC to the Network with an Ethernet cable.
Ethernet crossover cable	• Connect a service PC to the monitor's Ethernet connector with a crossover cable.

1.8 Prepare the patient monitor(s)

1. If not done yet, turn the patient monitor(s) on and wait until the normal monitoring screen appears.
2. Before transferring any software, verify that patient is discharged from the monitor and enable the the download mode from Service Menu.

   Monitor Setup > ***Install/Service*** (16,4,34) > ***Service*** (26,23,8) > ***SW Management*** > ***SW Download***
3. Configure the patient monitor(s) for the software installation. Follow the appropriate procedure below.

NOTE: When the patient monitor entered the download mode, the patient monitor will stop communication with central station(s) and all the parameter modules will be powered off.

Connection method to be used	**Procedure**
Network	1. Verify that the patient monitor is connected to a live network. 2. Determine if the Monitor's Network is configured to use static (manual) configuration mode. (NOTE: You will need to configure your service laptop to operate in the same mode.) Refer to the PROCARE Monitor B40/B20 Technical Manual for further information. 3. Record the IP address: IP address:_____ Netmask:_____ Default gateway: _____.
Ethernet crossover cable	1. Verify that the monitor's network is configured in manual configuration mode. If needed, configure the network to operate with static IP address. Refer to the PROCARE Monitor B40/B20 Technical Manual for further information. 2. Record the IP address: Static IP:_____ Netmask:_____.

1.9 Prepare the service PC

Configure the service PC to communicate with the patient monitor. Follow the appropriate procedure below:

If your service PC is running any firewall protection or networking services, such as Cisco Systems VPN, BlackIce, Sophos, or a wireless network card, you may need to disable these services on the service PC before you use Software Transfer Utility.

NOTE: Depending on the administrative permissions placed on your computer by your IT department, it may not be possible to disable firewall/networking services using the procedure below. If the procedure does not work, disable the firewall/networking service(s) using the ***Task Manager*** to end the process. Simultaneously press ***Ctrl-Alt-Delete***, then select ***Task Manager***, then select the ***Processes*** tab. Click on ***Image Name*** to alphabetize the list. Locate and highlight all of the .exe filenames of the firewall/networking services (e.g., for Sophos, select**:** ***SAVAdminService.exe, SavMain.exe***, and ***SavService.exe***), then select ***End Process***. Answer ***Yes*** to the warning.

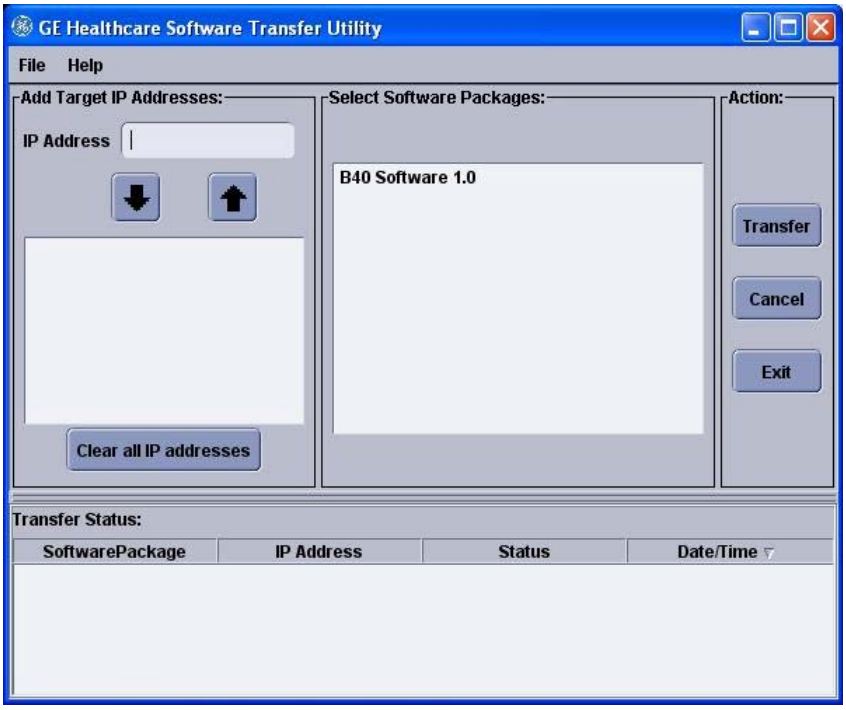
1. Select one of the following from the toolbar:
   - Windows XP: ***Start > Control Panel > Administrative Tools > Services.***
   - Windows 2000**:** ***Start > Settings > Control Panel > Administrative Tools > Services.***
2. In the list of available firewall/networking services, double-click the service (e.g., Sophos Client Firewall) to be disabled.
3. In the specific service (e.g., Sophos Client Firewall) properties window, select ***Stop.***
4. Verify that the ***Service status*** reads ***Stopped***.
5. Select ***OK*** and close all windows.
6. Repeat these instructions for all VPN, wireless network cards or any firewall protection programs running on your PC.

NOTE: If you are unsure of the firewall/networking services on your PC, contact your local IT administrator for details. Windows 2000 and XP PCs allow you to send a list of services to your IT administrator.

Connection method to be used	Procedure
Network	1. Configure the service PC's network settings to communicate with the patient monitor in the Network. Refer to Windows documentation on how to verify and change the IP address of theservice PC:- If manual configuration mode is used on the monitor, configure a unique IP address and a valid subnet mask. The service PC shall be configured to operate in the same subnet with the patient monitor's network. If default gateway is in use in Network, configure also the default gateway address to the service PC. 2. Verify that the service PC is able to perform a network ping to the patient monitor.
Ethernet crossover cable	1. Configure the service PC's network settings to operate in a manual configuration mode. Configure a unique IP address and a valid subnet mask. The service PC shall be configured to operate in the same subnet with the patient monitor's network. 2. Verify that the service PC is able to perform a network ping to the patient monitor.

1.10 Start the Software Transfer Utility

Insert the CD containing the software into the service PC's CD-drive. The ***GE Healthcare Software Transfer Utility*** window should launch automatically. If not, double-click the ***MyComputer*** icon on the PC desktop, and double-click the "***auto.bat***" file in the CD directory.



1.11 Specify the IP address(es) of the target patient Monitor(s)

There are two alternate methods to specify the IP addresses of the target patient monitors. You can either enter the IP addresses manually (step 1 below) or import a text file that contains the IP addresses (step 2 below).

1. To manually enter the IP addresses, complete the following steps:

   a. Under ***Add Target IP Addresses***, enter the IP address of a patient monitor where you want to transfer the software.

   b. Select the down arrow button to add this IP Address to the displayed list.

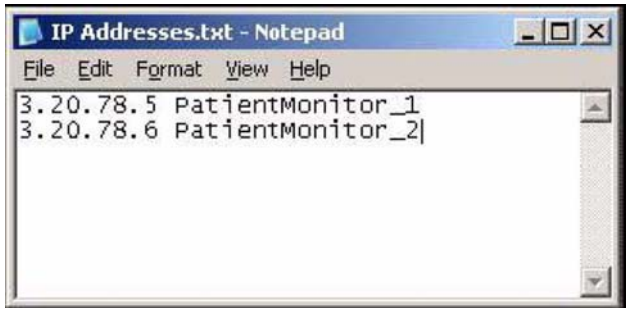
   c. Repeat steps a and b for each additional patient monitor.

   NOTE: To save the list of displayed IP addresses in a text file (.txt) format, select ***File*** -> ***Export IP File***. Specify the destination and file name of this .txt file.

2. To automatically upload a text file (.txt), complete the following steps:

   a. Open Windows Notepad®.

   b. Enter one IP address per line. To add a brief descriptor (e.g., PatientMonitor_1), enter a <space> after the IP address and type the descriptor. See the following example:



c. Select ***File*** -> ***Save***. Specify the destination and file name of this text file (.txt) so you can easily navigate to it.

d. From the GE Healthcare Software Transfer Utility window, select ***File*** ->***Import IP File***. Navigate to the .txt file containing the IP addresses. The IP addresses display in the Add Target IP Addresses list.

3. Verify these IP address(es) are the destination(s) where you want to transfer the software.

NOTE: To remove an incorrect IP address from the displayed list, select the IP address and click the ***up arrow*** button.

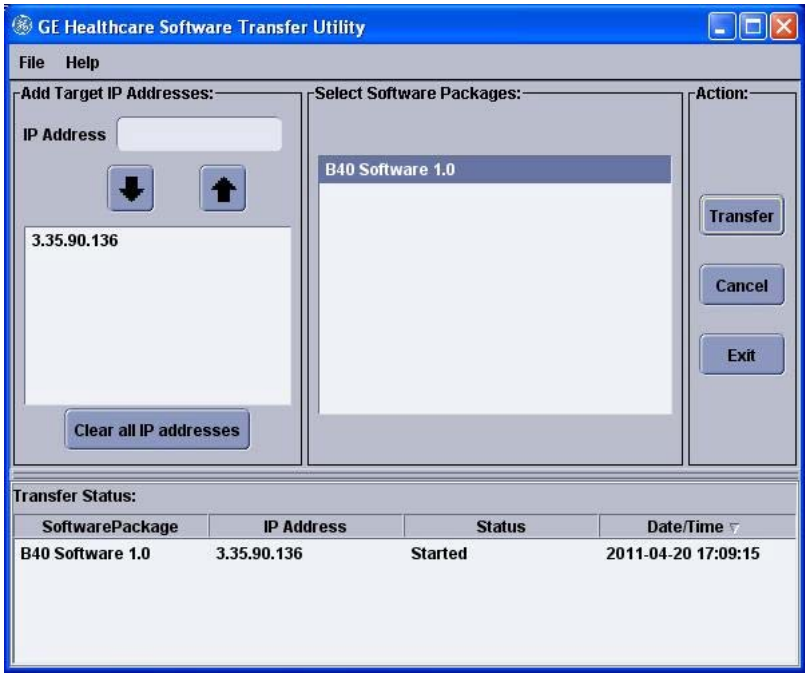
1.12 Transfer the software

Once the GE Healthcare Software Transfer Utility > Add Target IP Addresses list is populated with the IP addresses of the target patient monitors, you are ready to transfer the software. Complete the following procedure to transfer the selected software package:

1. Under Select Software Packages, select the software package you want to transfer to the monitor.
2. Select ***Transfer***. Transfer status information displays in the ***Transfer Status*** window at the bottom of the ***GE Healthcare Software Transfer Utility*** window.

NOTE: Software can only be transferred on a limited number of target monitors at a time. As a result, the software transfer may occur in sequential groupings.

NOTE: To cancel a software transfer, select ***Cancel***. Selecting Cancel only cancels the transfer of the queued software package(s) identified in the ***Transfer Status*** window. Once a software package transfer begins, you cannot cancel it.



3. Verify the transfer status of all selected software packages indicates ***Success*** in PC. NOTE: If the transfer status show the ***Failed*** information, please do not activate the software. You should redo the software download.
4. Select ***Exit***.

Software Transfer to destination monitor(s) is now completed. Next Step is to activate the transferred software.

NOTE: A restart is needed when the monitor exit download mode. But you can do the automatic restart by activation or you can perform a restart without activation.

1.13 Activate the software

NOTE: LOSS OF MONITORING — To activate software, the patient monitor must be in a discharged state. Before activating any software, verify that patient is discharged from the patient monitor.

NOTE: Monitor software activation will automatically restart the patient monitor as part of the activation process.

NOTE: Contact GE Healthcare to get the latest version of the user and service documentation.

NOTE: The existing platform settings of the patient monitor will retain and are not impacted by the activation of the new software. However, any platform and clinical settings that are new and specific to the activated software version are set to factory defaults and may require manual configuration. Refer to the latest version of the "PROCARE Monitor B40/B20 Default Configuration Worksheet" for more information.

1. Select **Monitor Setup** > ***Install/Service*** > ***Service*** > ***SW Management*** > ***Active Inactive SW***. The ***Soft active status*** displays.
2. Check that the software to be activated is listed in the Inactive software status.

3. Select ***Activation*** to activate the inactive software.

1.14 Perform post software activation checkout

Verify that the software version you activated in the section “Activate the software” is now active:

1. Check that the patient monitor starts up normally after the automatic restart initiated by the software activation and no error messages appear on the screen.
2. Select **Monitor Setup** > ***Install/Service*** > ***Service***.
3. Verify that the active software version is correct.

NOTE: For B40/B20, no need do any maintenance checkout after software installation, because software DOEC is minor and it is verified be engineering before release.

APPENDIX B: ElectroMagnetic Compatibility

Table 1 Guidance and manufacturer's declaration – electromagnetic emissions

Guidance and manufacturer's declaration – electromagnetic emissions		
The B40/B20 monitor is intended for use in the electromagnetic environment specified below. The customer or the user of the B40/B20 should assure that it is used in such an environment.		
Emissions test	**Compliance**	**Electromagnetic environment - guidance**
RF emissions CISPR 11	Group 1	The B40/B20 uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class A	The B40/B20 Patient Monitor is suitable for use in all establishments other than domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Hermonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/ flicker emissions IEC 61000-3-3	Class A	

Table 2 Guidance and manufacturer's declaration – electromagnetic immunity

Guidance and manufacturer's declaration – electromagnetic immunity			
The B40/B20 is intended for use in the electromagnetic environment specified below. The customer or the user of the B40/B20 should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	±6 kV contact ±8 kV air	±6 kV contact ±8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transients/bursts IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/output lines	±2 kV for power supply lines ±1 kV for input/output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV differential mode ±2 kV common mode	±1 kV differential mode ±2 kV common mode	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply lines IEC 61000-4-11	<5% U_T (>95% dip in U_T) for 0.5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles <5% U_T (>95% dip in U_T) for 5 sec	<5% U_T (>95% dip in U_T) for 0.5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles <5% U_T (>95% dip in U_T) for 5 sec	Mains power quality should be that of a typical commercial or hospital environment. If user of the equipment requires continued operation during power mains interruptions, it is recommended that the equipment be powered from an uninterruptible power supply or a battery.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic field should be at levels characteristic of a typical location in a typical commercial or hospital environment.
NOTE U_T is the a.c. mains voltage prior to application of the test level.			

Table 3 Guidance and manufacturer's declaration – electromagnetic immunity

Guidance and manufacturer's declaration – electromagnetic immunity			
The B40/B20 is intended for use in the electromagnetic environment specified below. The customer or the user of the B40/B20 should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz	3 Vrms	Portable and mobile RF communications equipment should be used no closer to any part of the equipment, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance** $d = 1.2\sqrt{P}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz	3 V/m	$d = 1.2\sqrt{P}$ 80 MHz to 800 $d = 2.3\sqrt{P}$ 800 MHz to 2.5 where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and *d* is the recommended separation distance in metres (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, [a] should be less than the compliance level in each frequency range. [b] Interference may occur in the vicinity of equipment marked with the following symbol:
NOTE 1 At 80 MHz and 800 MHz, the higher frequency range applies. NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			
[a] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicated theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the equipment is used exceeds the applicable RF compliance level above, the equipment should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the equipment. [b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.			

Table 4 Recommended separation distances between portable and mobile RF communications equipment and the B40 monitor

Recommended separation distances between portable and mobile RF communications equipment and the B40.

The B40/B20 monitor is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the equipment can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the equipment as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter W	**Separation distance according to frequency of transmitter** m		
	150 kHz to 80 MHz $d = 1.2\sqrt{P}$	80 MHz to 800 MHz $d = 1.2\sqrt{P}$	800 MHz to 2.5 GHz $d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.37	0.37	0.74
1	1.17	1.17	2.33
10	3.69	3.69	7.38
100	11.67	11.67	23.33

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE 1 At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

APPENDIX C: Installation and checkout form, B40/B20

Customer	
Service	
Service engineer	Date

Monitor Installation			

OK = Test OK **N.A. = Test not applicable** **Fail = Test failed**

Electrical Safety Tests		**OK**	**N.A.**	**Fail**
2.4. Power Outlet Test		☐	☐	☐
2.5. Power cord and plug		☐	☐	☐
2.6. Ground (Earth) Integrity		☐	☐	☐
Ground continuity test	≤ 0.1 ohms/ ≤ 0.2 ohms	☐	☐	☐
Impedance of protective earth connection	≤ 0.1 ohms/ ≤ 0.2 ohms	☐	☐	☐
2.7. Ground (earth) wire leakage current tests		☐	☐	☐
Normal Condition (NC)	≤ 500 µA/ ≤ 300 µA	☐	☐	☐
Single Fault Condition (SFC)	≤ 1 mA	☐	☐	☐
2.8. Enclosure (Touch) leakage current test		☐	☐	☐
Normal Condition (NC)	≤ 100 µA/	☐	☐	☐
Single Fault Condition (SFC)	≤ 500 µA/ ≤ 300 µA	☐	☐	☐
2.9. Patient (source) leakage current test		☐	☐	☐
Normal Condition (NC)	≤ 10 µA/	☐	☐	☐

Electrical Safety Tests		**OK**	**N.A.**	**Fail**
Single Fault Condition (SFC)	≤ 50 µA/	☐	☐	☐
2.10. Patient (sink) leakage current test	≤ 50 µA/	☐	☐	☐
Notes				

Visual Inspection			**OK**	**N.A.**	**Fail**
3.1. Visual inspection			☐	☐	☐

Functional Inspection		**OK**	**N.A.**	**Fail**
3.2.1. Start-up		☐	☐	☐
3.2.2. Display		☐	☐	☐
3.2.3. Frame unit		☐	☐	☐
3.2.4. Parameters measurements		☐	☐	☐
3.2.5. Recorder		☐	☐	☐
3.2.6. Network connection		☐	☐	☐
3.2.7. Conclusion		☐	☐	☐
Notes				

Signature

APPENDIX D: Maintenance and checkout form, B40/B20

Customer	
Service	
Service engineer	Date

Monitor Installation			

Measuring equipment used:				
Equipment / tool:	Manufacturer:	Model/Type/Part Number:	Serial Number / ID:	Calibration Date:

OK = Test OK **N.A. = Test not applicable** **Fail = Test failed**

Electrical Safety Tests		**OK**	**N.A.**	**Fail**
2.4. Power Outlet Test		☐	☐	☐
2.5. Power cord and plug		☐	☐	☐
2.6. Ground (Earth) Integrity		☐	☐	☐
Ground continuity test	≤ 0.1 ohms/ ≤ 0.2 ohms	☐	☐	☐
Impedance of protective earth connection	≤ 0.1 ohms/ ≤ 0.2 ohms	☐	☐	☐
2.7. Ground (earth) wire leakage current tests		☐	☐	☐
Normal Condition (NC)	≤ 500 µA/ ≤ 300 µA	☐	☐	☐
Single Fault Condition (SFC)	≤ 1 mA	☐	☐	☐

Electrical Safety Tests		**OK**	**N.A.**	**Fail**
2.8. Enclosure (Touch) leakage current test		☐	☐	☐
Normal Condition (NC)	≤ 100 µA/	☐	☐	☐
Single Fault Condition (SFC)	≤ 500 µA/ ≤ 300 µA	☐	☐	☐
2.9. Patient (source) leakage current test		☐	☐	☐
Normal Condition (NC)	≤ 10 µA/	☐	☐	☐
Single Fault Condition (SFC)	≤ 50 µA/	☐	☐	☐
2.10. Patient (sink) leakage current test	≤ 50 µA/	☐	☐	☐
Notes				

Visual Inspection		**OK**	**N.A.**	**Fail**
4.1.2. General		☐	☐	☐
Notes				

Functional Inspection		**OK**	**N.A.**	**Fail**
4.2.1. General		☐	☐	☐
4.2.2. Display		☐	☐	☐
4.2.3. Keyboard(s)		☐	☐	☐
4.2.4. Time and date		☐	☐	☐
Notes				
4.2.5. Hemo Module		☐	☐	☐
. ECG measurement				
1. Normal Sinus Rhythm		☐	☐	☐
2. Pacemaker Detection		☐	☐	☐
3. Asystole Detection		☐	☐	☐
4. Leads Off Detection		☐	☐	☐

Functional Inspection		OK	N.A.	Fail
Notes				
. Respiration measurement				
5. Respiration Rate		☐	☐	☐
6. Apnea Detection		☐	☐	☐
Notes				
. Temperature measurement		☐	☐	☐
7. Temperature detection		☐	☐	☐
Notes				
. Invasive blood pressure measurement				
8. Zeroing		☐	☐	☐
9. Static Pressure		☐	☐	☐
10. Pressure Waveforms		☐	☐	☐
Notes				
. SpO2 measurement				
11. Test measurement		☐	☐	☐
Notes				
. Non Invasive Blood Pressure measurement				
12. NIBP Leak Test		☐	☐	☐
13. NIBP calibration		☐	☐	☐
14. NIBP hose detection		☐	☐	☐
Notes				
4.2.6. Loudspeaker		☐	☐	☐
4.2.7. Monitor software		☐	☐	☐
4.2.8. Watchdog circuitry		☐	☐	☐
4.2.9. Batteries		☐	☐	☐

Functional Inspection		**OK**	**N.A.**	**Fail**
4.2.10. Network		☐	☐	☐
4.2.11. Final cleaning		☐	☐	☐
Notes				

Used Spare Parts			
Notes			

Signature

APPENDIX E Service check form, Single-width Airway Module E-miniC

Customer		
Service	Module type	S/N
Service engineer		Date

Measuring equipment / test gases used:				
Equipment / tool / gas:	Manufacturer:	Model/Type/Part Number:	Serial Number / ID:	Calibration Date:

OK = Test OK **N.A. = Test not applicable** **Fail = Test failed**

General	**OK**	**N.A.**	**Fail**		**OK**	**N.A.**	**Fail**
4.2. Visual inspections	☐	☐	☐				
Notes							
CO_2 measurement							
1. Check Mini D-Fend	☐	☐	☐				
2. Flow measurement offset					±10 ml/min		
3. Ambient pressure	☐	☐	☐	4. Zero valve check	☐	☐	☐
5. Nafion tube	☐	☐	☐				
6. Leak test					≤6 mmHg/20 sec		
7. Check the flow rates							
Sampling flow					135...165 ml/min		
8. Working pressure							
Amb-Work					20...50 mmHg		

General	OK	N.A.	Fail		OK	N.A.	Fail
9. Gas calibration	☐	☐	☐	10. Occlusion detection	☐	☐	☐
11. Check D-fend	☐	☐	☐	12. Apnea detection	☐	☐	☐
Notes							

General	OK	N.A.	Fail		OK	N.A.	Fail
13. Final cleaning	☐	☐	☐				

Notes

Used spare parts			

Signature

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